

# California's Environmental Principles



The State of California's Environmental Principles and Concepts were approved in 2004 under a law referred to as the California Education and the Environment Initiative (EEI).

The law called for the development of Environmental Principles and Concepts that are compatible with the State's academic content standards and, as such, would become a formal part of California's K-12 education system. The EEI Curriculum, which this unit is part of, is designed to help students simultaneously achieve mastery of selected academic content standards and California's Environmental Principles and Concepts.

## Principle I

### People Depend on Natural Systems

The continuation and health of individual human lives  
and of human communities and societies  
depend on the health of the natural systems that provide essential goods  
and ecosystem services.

## Principle II

### People Influence Natural Systems

The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems  
are influenced by their relationships with human societies.

## Principle III

### Natural Systems Change in Ways that People Benefit from and can Influence

Natural systems proceed through cycles  
that humans depend upon, benefit from and can alter.

## Principle IV

### There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing between Systems

The exchange of matter between natural systems and human societies  
affects the long-term functioning of both.

## Principle V

### Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

Decisions affecting resources and natural systems  
are based on a wide range of considerations  
and decision-making processes.

# **DRAFT**

**for discussion purposes only**

## **California Education and the Environment Initiative**

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# Contents

Overview . . . . .	4
California Connections . . . . .	6
Background . . . . .	8
Unit Planner . . . . .	12
Differentiated Instruction & Extensions . . . . .	16
Unit Assessment . . . . .	18
Unit Resources . . . . .	21

## Lesson Plans

<b>Lesson 1</b> What Is a Population? . . . . .	22
<b>Lesson 2</b> Making a Living . . . . .	28
<b>Lesson 3</b> The Higher, the Fewer . . . . .	36
<b>Lesson 4</b> It Is All Connected . . . . .	44
<b>Lesson 5</b> Cause and Effect? . . . . .	52
<b>Lesson 6</b> Making Choices: The Effects of Human Consumption . . . . .	60

## Supporting Materials

<b>Activity Masters Index</b> . . . . .	68
<b>Unit Assessment</b> . . . . .	70
<b>Activity Masters</b> . . . . .	72
<b>Unit Visual Aids</b> . . . . .	98



# Overview

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Students know there are many different types of organisms in the world. They may not have considered how those organisms make their livings; that is, how they obtain the food they need to maintain their bodies. As students learn about organisms, one of the first topics they study is their function in the environment or ecosystem—how they make their livings. In this unit, Energy—

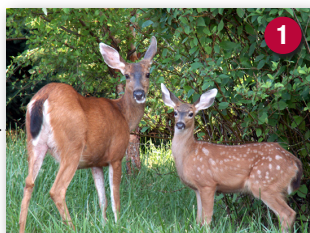
Pass it On!, students learn about the roles populations of organisms fill in ecosystems.

Humans are among the organisms that influence Earth’s ecosystems and other organisms living within them. Human actions influence the health and functioning of ecosystems; conversely, we are dependent upon ecosystems for our food and the materials that we consume. We are part of

the ecosystems in which we live and from which we obtain materials—and into which we release the byproducts of our activities.

By learning about the functions of organisms within an ecosystem, students gain an understanding of how all living things, including humans, depend on both the physical environment and the interactions among organisms. The lessons in

## At a Glance



### What Is a Population?

Explore the term population through the eyes of California wolverines.



### Making a Living

Discover functions of organisms in the Sierra Nevada mountains.



### The Higher the Fewer

Investigate energy flow in an ecosystem.





## California Content Standard

**6.5.** Organisms in ecosystems exchange energy and nutrients among themselves and with the environment.

**6.5.c.** Students know populations of organisms can be categorized by the functions they serve in an ecosystem.

this unit explore three related ecological ideas: what a population is, how populations function, and how energy and materials are transferred through ecosystems. In addition, the lessons explore the role of humans as consumers in ecosystems, which helps students understand our place in the environment. As students learn ways in which humans depend on ecosystems, they begin to understand ways we influence the natural systems upon which we depend.

Through California Connections: Where Are the Wolverines? in Lesson 1, students learn about wolverines in the Sierra Nevada Mountains and are introduced to the meaning of the term “population.” Lesson 2 focuses on the main functions that organisms serve in ecosystems, especially the

## California Environmental Principle IV

The exchange of matter between natural systems and human societies affects the long-term functioning of both.

**Concept A:** Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts.

**Concept B:** Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect.

ways in which they obtain food. Lesson 3 addresses the loss of energy at each trophic level. Lesson 4 discusses changes in forest ecosystems and some of the effects that human activities have on the forest environment. Students return to the Where Are the Wolverines? in Lesson 5 to learn that

changes in ecosystems do not necessarily have just one cause. The final lesson uses a persuasive essay writing assignment as an opportunity for students to apply their understanding that issues, including issues relating to natural and human interactions, have more than one side.



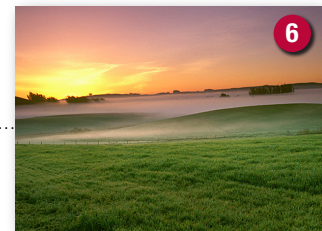
### It Is All Connected

Discuss how ecosystem changes affect energy flow.



### Cause and Effect?

Investigate how people influence energy flow in ecosystems.



### Making Choices: The Effects of Human Consumption

Examine how human use of natural resources influences ecosystems.

# Where Are the Wolverines?

**Wolverines once roamed the Sierra Nevada Mountains. However, nobody has seen one in California since 1953. Today, most scientists believe the mammal either no longer lives in the state, or is very rare. What happened to California's wolverines?**



With thick bushy coats, broad heads, and short furry ears, wolverines look like small black bears. Along with their sharp teeth and claws, they

use foul-smelling musk oil to defend themselves. The musk oil makes them smell like a skunk. These features earned the wolverine the nickname of “skunk bear.”

Wolverines eat many kinds of foods. Their prey includes hoary marmots, mice, gophers, deer, and pikas. Pikas are small rabbit-like animals that live at high elevations. Wolver-

ines are both carnivores and scavengers. Carnivores kill and eat meat. Scavengers feed on dead animals, also called carrion. Carrion is an especially important part of the wolverine's diet in winter.

Wolverines are about the size of a small collie. They are the largest member of the weasel family. They are also the most ferocious. Wolverines are remarkably strong for their size. They have been known to kill animals as large as a moose. Their powerful jaws and sharp claws make them powerful predators. Their teeth are sharp and strong enough to chew through bone and carrion that has frozen in the snow.

What wolverines lack in size, they

make up for with aggressiveness. A large wolverine might weigh only 40 pounds. But it will challenge much larger predators and steal their prey. Hunters and trappers have witnessed 1,000-pound grizzly bears leaving their meals behind when a wolverine approaches.

Wolverines normally live high in the mountains. They usually are found in high open areas where it is too cold and snowy for trees to grow. Wolverines share their habitat with populations of other small- and medium-size mammals, birds, insects, and fungi that they hunt and eat. Other, larger predators like mountain lions, bears, and wolves also live in the same region. These predators compete with wolverines for food.

Wolverines are well adapted to live and hunt in the snow. Their fur is thick and keeps them warm. Their feet are large so they can walk easily on snow. If they are hungry, they can even use their long claws to dig 10 feet into the snow to find hibernating animals.

Snow plays a very important role in wolverine survival. Female wolverines raise their babies in dens built in deep snow layers. These dens are long, complex snow tunnels that protect the young from predators and provide warmth in the cold climate. If there is not enough snow, wolverine babies may not survive to adulthood.



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Caption to come



Two things help determine the size of the territory each wolverine needs. One is having adequate sources of food. The other is being able to find a suitable place for a den. Wolverines cover many miles in a day of hunting. Each animal needs lots of space to hunt and raise its young. Wolverines fight off other wolverines that try to enter their home territory. This limits the total number of wolverines that might live in a region. It is one of the reasons that wolverines are considered one of the rarest mammals in North America.

While wolverine numbers were never very high, there were enough around in the 1800s that trappers considered them pests. Trappers would lose money when hungry wolverines stole animals from their traps. The trappers used poisoned bait to kill wolverines.

Early settlers reported wolverines stealing food from their cabins. The “skunk bears” sometimes ruined settlers’ belongings with their musk and urine marking. Wolverines were considered particularly fierce and dangerous animals. They were often killed when the opportunity arose.

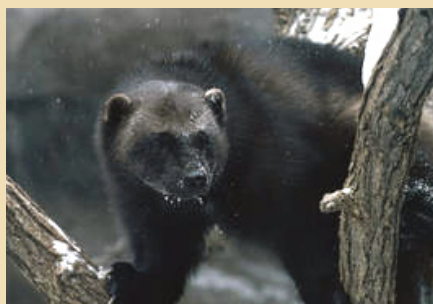
Because wolverines are very secretive and travel across huge ranges, they are hard for scientists to study. Many things about the species are not known. But one thing is sure. Wolverines used to live throughout the higher reaches of the Sierra Nevada Mountains. Now they are exceedingly rare. Their decline is a mystery scientists want to explore.

## Where Are the Wolverines?—Part 2

While wolverines are no longer seen in California they are believed to still live here. Scientists set out to explore why they have become so rare. Since wolverines need snow for their dens, a drop in snow levels could explain the decline. A decrease in the popula-

tion of their prey species might also explain the lack of wolverines. So scientists have studied weather patterns and prey populations over the past 150 years. The studies have shown that climate and prey populations have not changed much. Food shortages and lack of snow are not believed to have caused the decline of the wolverine.

What has changed over the last 150 years? For one thing, the ways people use the land have changed a lot. The discovery of gold at Sutter’s Mill in



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1848 began a major shift in the region. Is this what caused the wolverine to vanish?

After the Gold Rush started, miners and early settlers built many new towns in the Sierra Nevada Mountains. In 1860, about 150,000 people lived in the region. By 1960, that number grew to around 275,000. The population reached 650,000 in 1990 and will soon pass 1,000,000.

The Gold Rush paved the way for many new industries. In lower elevations, forests were cut to provide lumber for mines and houses. By 1880, over 1.5 million acres of pine forests had been cleared. Different kinds of trees grow at higher elevations. The lumber from these trees is not as good for building, so there was not as much logging in the areas where wolverines generally lived.

Gold Rush mining practices caused huge amounts of soil to wash into mountain streams. This changed the ways the rivers flowed. Farmers also used a lot of water. They took it from

streams to water, or irrigate, their crops. In fact, they used more land for farming and ranching in 1860 than in any year since. Irrigation projects continued to grow until the 1920s. They have leveled off since then.

Cattle grazing was common at lower elevations. In the higher grasslands where wolverines lived, ranchers grazed sheep. This practice cleared huge areas of native grasses in the late 1800s. Ranchers worried about wolverines that hunted and killed their livestock. Like trappers, they also poisoned wolverines when they became a threat to ranchers’ income.

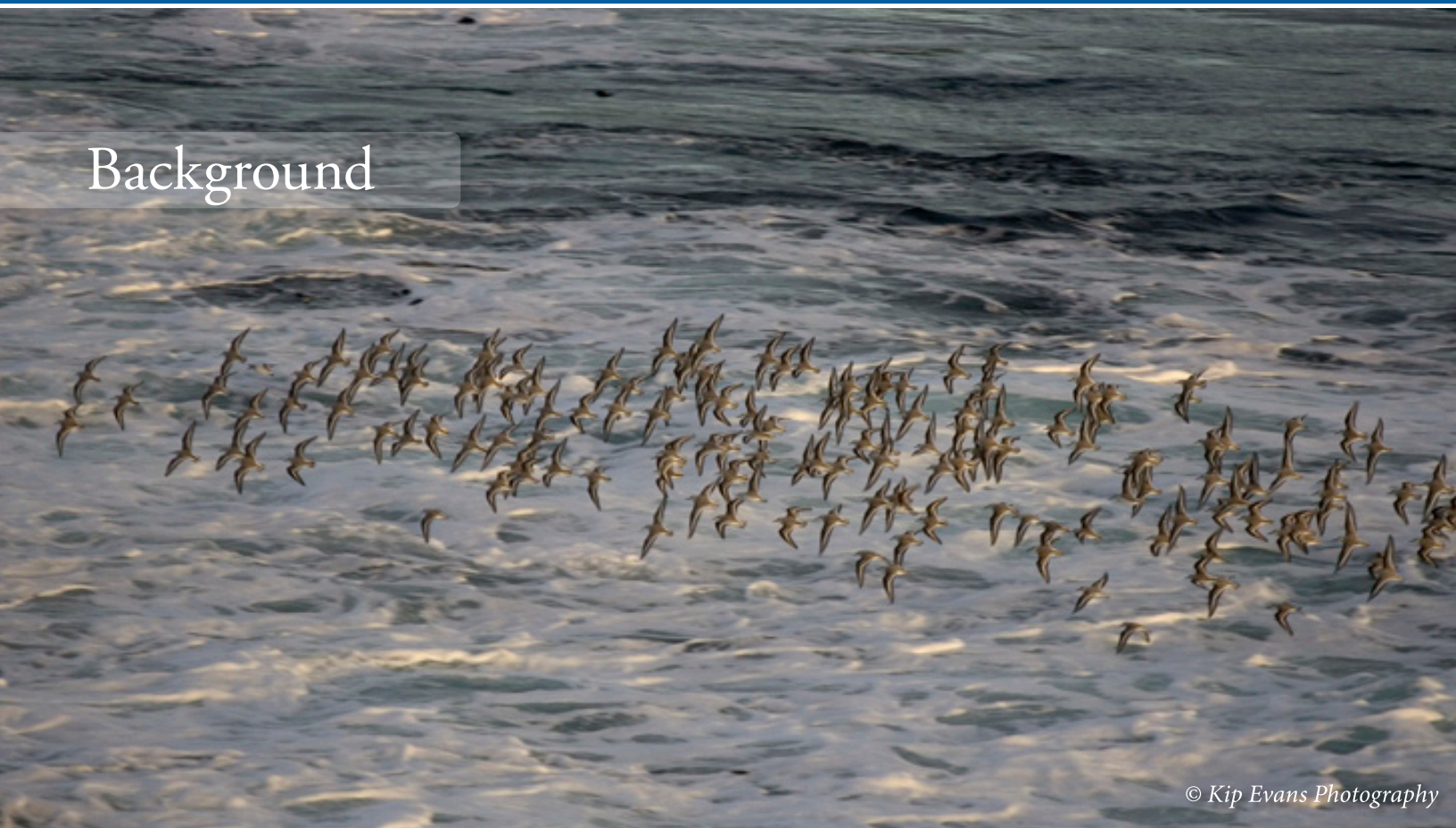
Parks were created at Yosemite Valley and Calaveras Big Trees in the 1860s. These were the first parks in the Sierra Nevada Mountains. More parks followed. Tourism brought more people to the area. More people meant more contact with wolverines. Some people were afraid of wolverines and sometimes killed them to protect themselves.

The development of mining, grazing, farming, logging, and recreation all affected the habitat of the wolverine. Finding places to build dens and raise young became difficult. The predators no longer had unbroken home ranges in which to hunt. As their habitat changed, the numbers of some prey species, like the pika, also decreased. Hunters killed deer, reducing an important winter food source for the wolverines. It grew harder and harder for the wolverine population to maintain its historical size in the Sierra Nevada Mountains.

The mystery is solved. No one thing caused wolverines to disappear from California’s mountains. A combination of factors contributed to the population decline.



# Background



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While students may have heard the term population they probably have heard it used in the context of numbers of people. They may have heard the population of California is X, or the population of the United States is Y.

It is implicit in such statements of population that they refer to the number of humans currently living in the place.

In scientific studies, the term **population** has a somewhat different meaning. Understanding the scientific meaning of population and that all organisms exist as populations helps students to understand that people are part of an ecosystem and that we are governed by the same natural laws as other organisms.

In ecological studies, the term population applies to the number of a particular species in a place at a particular time, or the members of a

species in a place. Examples of statements of populations might be:

- Two hundred fifty perch were in the pond last summer.
- Seventy-five field mice lived in the meadow last week.
- One hundred fifty oak trees were in the valley before the fire.
- The entire deer population left after the houses were built.
- The population of raccoons in the nearby forest became a problem when they discovered the trash cans.

Studying populations of organisms enables ecologists to understand the



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roles that both individuals and groups of individuals play in ecosystems.





The activities in this unit help the students understand the scientific use of the term population and the ways that human populations interact with other organisms in ecosystems.

To facilitate discussion of organisms and their functions in ecosystems, scientists have given names to the various roles or functions that organisms serve. Plants and algae are called **producers** because they use simple chemicals such as carbon dioxide and water, and energy from the sun, to produce complex chemicals such as sugars and starches through the process of **photosynthesis**. The organism then uses the sugars and starches as a source of energy. Oxygen is given off as a byproduct of photosynthesis.

Some forms of bacteria use chemicals and energy from volcanic vents deep in the ocean or in areas such as Yellowstone National Park to produce complex chemicals through the process of chemosynthesis. The emphasis in this unit, however, is on the more common photosynthetic organisms.

Organisms that feed on other organisms are called **consumers**. They consume or feed on other organisms, thereby obtaining the materials they need to build and maintain their bodies and the energy they require to live. Some consumers (herbivores) feed primarily on plants. Others (carnivores) feed primarily on other animals. Omnivores are consumers that feed on both plants and animals. Some consumers eat or consume their food in its entirety, while others, such as mosquitoes, ticks, or other parasites feed on their hosts without killing them.

**Decomposers** obtain their nutrients by producing chemicals called enzymes that digest already dead organisms. Decomposers return nutrients to the environment, thereby enabling plants to live. Without the

actions of decomposers, nutrients would remain tied up in dead organisms and unavailable to plants. Earth also would be littered with dead bodies! Bacteria and fungi are common decomposers.

Feeding is the transfer of energy and materials from one organism to another. This transfer can be seen as a series of steps, often represented as a **food chain**. Food chains follow the path as one organism eats another.

The steps in a food chain are referred to as **trophic levels**. Organisms that eat plants are called herbivores and are first trophic level consumers or **primary consumers**. Animals that eat other animals are called carnivores and are second trophic level consumers or **secondary consumers**. Other carnivores may eat second level consumers and are called third level or **tertiary consumers**, and so on. The last carnivore in the chain is called the top carnivore.

Here is an example of one food chain: grass (producer) eaten by grasshopper (herbivore, first trophic level), eaten by a frog (first carnivore, second trophic level), eaten by a snake (second carnivore, third trophic level), eaten by a hawk (top carnivore, fourth trophic level).

Of course, plants and animals are eaten by more than one kind of organism. In the ecosystem above, deer,

rabbits, and birds might also eat the grass. A bird or lizard might eat the grasshopper, and a water bird such as an egret or a fish might eat the frog. The hawk might eat mice or gophers in addition to the snake. A diagram of such complex feeding patterns would produce a **food web**. A food web represents these relationships more realistically and shows how plants and animals are connected in ways that help them survive. Organisms use energy in the process of living. So, not all energy that enters one organism is available to the organism(s) that feed on it. Some of the energy is used in metabolic processes like digestion of food and elimination of wastes. Some energy



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is used for such things as movement, and much chemical energy remains in waste products that are eliminated by organisms. Thus, as the energy passes through the trophic levels in a food chain or web, most is lost to the environment, primarily as heat. Less energy is available to the organisms at each **trophic level**.

The same general principle applies to the foods that humans consume. Some is added to our bodies as we grow and as we replace cells that die, but most of the matter that we take in as food is eliminated from our bodies. If this were not true, every ounce of food that we consume would stay on our bodies.

An **energy pyramid** illustrates how the amount of energy varies at different trophic levels. An energy pyramid has a wide base, with lots of energy (from the sun) available to producers. Less energy is available for the herbivores that feed on the plants, and still less for the first carnivores. At each step in a food chain, less energy is available for the next organisms. Thus, a broad base (lots of energy)

tapers to a small top, with only a small fraction of the original energy available to the top carnivore (the top of the pyramid). A commonly used estimate is that 10% of the energy at a given trophic level is available for the next level, but this is a rough approximation. The more steps in the food chain, the smaller the percentage of energy available to the top carnivore.

Pyramids can also be used to show the relative numbers and masses of organisms at various trophic levels in an ecosystem.

Since all animals depend on producers for their food, either directly or indirectly, they are called consumers. Humans, therefore, are consumers. We consume food resources and other things produced by natural systems.

Human use and consumption of resources from natural systems influence the

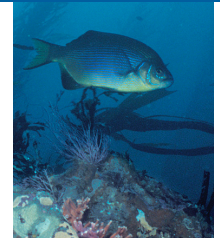
environment in many ways including the production of byproducts. Byproducts are incidental products created as the result of chemical reactions or manufacturing processes. They can be physical things, such as garbage or pollutants. Byproducts can also be excess heat energy released during the production of electricity.

The byproducts of human practices influence the transfer of matter through natural systems. For example, when trees are cut for lumber products, tree limbs and tops are generally left in the forest, where they may be a fire hazard or they may be compressed to form erosion-reducing ground cover. Bark and mill trimmings can be burned as waste, burned to produce usable heat energy, or used for such products as compressed wood fireplace logs, chip board, or garden mulch. Silt, released into

streams when soil is exposed at a logging site, can interfere with salmon or trout spawning or raise the water level,







resulting in flooding and the erosion of stream banks.

As we learn more about ecological interactions of organisms and their environment, we also learn about the byproducts of our own actions. The logging examples above illustrate how the quantities of resources consumed and the quantity and characteristics of the resulting byproducts can affect natural systems. This can be important information when making resource management decisions.

When part of an ecosystem is altered in a significant way, the entire ecosystem is affected. This is true whether the ecosystem is changed by natural forces such as a fire, avalanche, drought, or flood, or by humans for agriculture, building, logging, or other purposes. Logging a hillside, for example, obviously affects the hillside ecosystem but also may affect fish and other animals far downstream. If siltation caused by that logging results in the loss of salmon from a major stream, it may ultimately affect marine life hun-

dreds of miles away, such as seals that feed on the salmon. If trees or other vegetation grow back on the logged hillside, it may take many years for the streams to again be suitable for salmon spawning and still more years

for a population of salmon to rebuild. Ecosystem alterations can have consequences for diverse populations that are far-reaching in both space and time.



Caption to come

## Glossary

**Consumer:** An organism that obtains energy or matter from a natural system e.g., by eating other organisms.

**Decomposer:** An organism that obtains energy and matter by breaking down the remains of dead organisms.

**Energy pyramid:** A representation of the amount of energy available at different levels of a food chain.

**Food chain:** The sequence of feeding among organisms (e.g., mouse eating seed and in turn being eaten by an owl).

**Food web:** A complex pattern of several interacting food chains.

**Photosynthesis:** The process by which plants and algae convert light energy to chemical energy stored in carbohydrates.

**Population:** The number of individuals belonging to a species or several species living in a place at a given time.

**Primary Consumer:** In a food chain, the “first” consumer that obtains energy and matter by eating plants or algae.

**Producer:** An organism (plant or alga) that converts light energy to chemical energy stored in carbohydrates.

**Secondary consumer:** In a food chain, the “second” consumer that obtains energy and matter by eating a primary consumer.

**Tertiary consumer:** In a food chain, the “third” consumer that obtains energy and matter by eating a secondary consumer.

**Trophic level:** A step in the energy pyramid in which organisms obtain energy and matter in the same manner.

# Unit Planner

	Lesson	Learning Objective(s)	At a Glance
1	<b>What Is a Population?</b>	<ul style="list-style-type: none"> <li>■ Define a population.</li> </ul>	Students compare and contrast the definitions of the term population as given by: (a) a dictionary, (b) their science text or teacher, (c) classmates and parents, and (d) background information provided in this lesson.
2	<b>Making a Living</b>	<ul style="list-style-type: none"> <li>■ Give examples of the functions (producer, consumer, and decomposer) populations of organisms serve in an ecosystem.</li> <li>■ Identify humans as consumers within ecosystem.</li> </ul>	Students learn the functions of various organisms in the Sierra Nevada ecosystem. They learn terms scientists use, conduct research on the functions of organisms, and demonstrate their learning by completing a study guide identifying examples and answering questions about organisms and their functions in a specific ecosystem.
3	<b>The Higher, the Fewer</b>	<ul style="list-style-type: none"> <li>■ Explain how energy is transferred in an ecosystem and how the amount of available energy varies at the level of consumption (primary, secondary, and tertiary consumers).</li> </ul>	Students use energy pyramids and role-playing to learn about energy flow in a community. They start with 10,000 energy units, and as they read a script, they observe energy is lost at each trophic level in a food chain.
4	<b>It Is All Connected</b>	<ul style="list-style-type: none"> <li>■ Identify and describe byproducts generated by the human consumption of goods (matter) produced by natural systems (ecosystems).</li> </ul>	Students view before and after pictures of forested areas where human practices brought about changes. They discuss the changes in the ecosystems and the effects of those changes on the ecosystem. They also identify some of the unintended byproducts of logging practices.



Prerequisite Knowledge	Duration (minutes)	Materials Needed	Textbook Alignment
<ul style="list-style-type: none"> <li>Students should be able to use a dictionary and understand that dictionaries often give several definitions for a word.</li> <li>Students should understand the sixth grade science content standards 5.a. (energy transfer through photosynthesis and food chains) and 5.b. (food webs and decomposition).</li> </ul>	<b>Preparation:</b> 15 min. <b>Instruction:</b> 60 min.	<b>Cardstock:</b> Six sheets  <b>Editorial:</b> One newspaper editorial (that addresses a local land use issue, if possible)  <b>String:</b> Six 3-foot lengths  <b>Student dictionaries:</b> Approximately six per class  <b>Class supplies:</b> Blank paper, colored pencils or crayons  <b>Activity masters</b>  <b>Visual aids</b>	<b>Glencoe:</b> Pages 552-559  <b>CPO:</b> Pages 300, 301, 307  <b>Harcourt:</b> Unit 5 Lessons 1-2  <b>Holt:</b> Pages 554, 555, 557-559, 570-573, 582-603, 608-611  <b>Houghton Mifflin:</b> Unit D Ch. 8: 294-297, 301, 308-315, 318-323, 326  <b>MacMillan:</b> Pages 36-37, 52-53, 66, 72, 77, 94-95, 119, 124, 127-129, 133, 146, 422  <b>Prentice Hall:</b> Chapters 10-11
<ul style="list-style-type: none"> <li>Students know that energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.</li> <li>Students know that matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.</li> <li>Students should be able to use books or the Internet to obtain information about biomes or ecosystems.</li> </ul>	<b>Preparation:</b> 30 min. <b>Instruction:</b> 45 min.		
<ul style="list-style-type: none"> <li>Students should know that energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food chains and food webs.</li> <li>Students should also know that matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.</li> </ul>	<b>Preparation:</b> 15-30 min. <b>Instruction:</b> 45 min.		
<ul style="list-style-type: none"> <li>Students should understand that organisms are interdependent. They should be aware that food web relationships demonstrate the interdependence among organisms, and they should be able to identify examples of products made from wood logged in the Sierra Nevada Mountains</li> </ul>	<b>Preparation:</b> 20 min. <b>Instruction:</b> 45 min.		

# Unit Planner

	Lesson	Learning Objective(s)	At a Glance
5	<b>Cause and Effect?</b>	<ul style="list-style-type: none"> <li>Describe the effects of human practices on the transfer of matter through natural systems.</li> </ul>	Students read <i>Where are the Wolverines?—Part 2</i> . In groups, they review information about changes in the Sierras over the last 200 years, present summaries about causes and effects of environmental change, and discuss the difficulty in ascribing a given change to a single cause
6	<b>Making Choices: The Effects of Human Consumption</b>	<ul style="list-style-type: none"> <li>Provide examples of how the quantities of resources consumed, and quantity and characteristics of the resulting byproducts can affect natural systems.</li> </ul>	Students review realistic scenarios that propose changes in land use patterns. Working in pairs, students discuss both sides of their issue to develop an understanding of how use of resources affects natural systems. Then each student will write a persuasive essay, either supporting or opposing the proposed action.



Prerequisite Knowledge	Duration (minutes)	Materials Needed	Textbook Alignment
<ul style="list-style-type: none"> <li>Students should understand that humans obtain many products from and engage in many uses of forests. Obtaining those products affects the environment in many ways, including the transfer of matter through natural systems. Students should be familiar with the natural history of the wolverine. (See Where are the Wolverines?—Part 1.)</li> </ul>	<b>Preparation:</b> 15 min. <b>Instruction:</b> 45-60 min.	<b>Cardstock:</b> Six sheets  <b>Editorial:</b> One newspaper editorial (that addresses a local land use issue, if possible)  <b>String:</b> Six 3-foot lengths  <b>Student dictionaries:</b> Approximately six per class	<b>Glencoe:</b> Pages 552-559  <b>CPO:</b> Pages 300, 301, 307  <b>Harcourt:</b> Unit 5 Lessons 1-2  <b>Holt:</b> Pages 554, 555, 557-559, 570-573, 582-603, 608-611
<ul style="list-style-type: none"> <li>Students should understand ways in which organisms depend upon their habitat for survival. They must be able to discuss ways that human changes in the environment can affect organisms.</li> <li>Students should also understand that a persuasive essay is a form of a composition that: a. requires a clear position on a proposition, b. supports the position with organized and relevant evidence, and c. anticipates and addresses reader concerns and counter-arguments</li> </ul>	<b>Preparation:</b> 15 min. <b>Instruction:</b> 90 min. (two 45-minute sessions)	<b>Class supplies:</b> Blank paper, colored pencils or crayons  <b>Activity masters</b>  <b>Visual aids</b>	<b>Houghton Mifflin:</b> Unit D Ch. 8: 294-297, 301, 308-315, 318-323, 326  <b>MacMillan:</b> Pages 36-37, 52-53, 66, 72, 77, 94-95, 119, 124, 127-129, 133, 146, 422  <b>Prentice Hall:</b> Chapters 10-11

# Differentiated Instruction & Extensions

## Strategies for Below-Level Readers

When calling on students, allow time for processing. Let students discuss their answers with each other or with an aide before giving their final answer.

When definitions are called for (as in Lesson 1), provide direct instruction on the use of dictionaries or use simplified dictionaries (either in

English or in foreign languages).

If students have trouble changing dictionary definitions into their own words, work with the class to develop a class definition.

Pair low-level readers with more advanced readers when assignments call for research.

In Lesson 3, have students read the

## Strategies for Above-Level Readers

This unit introduces several vocabulary terms. Have students search for the terms (for example, “population,” “consumer,” “producer”) in popular publications and compare how the terms are defined and used in these publications with the way they are defined and used in the unit. Students can lead a class discussion on the use of these words or present a written summary.

Have students conduct research

using the Internet or other resources to extend their knowledge of populations of species discussed in this unit. Students can present their information orally, in writing, or as a poster.

Have students find data on how the population of a species has changed over time and graph the changes. Have them provide written explanations of their graphs, describing the changes in populations and the potential causes of the changes.

## Extension Ideas

Select small study plots and have students investigate populations of specific organisms at various times of day or in different seasons. Students should develop tables for recording population data; record and graph data; write a brief explanation of

each data set; and maintain the data and graphs for comparison in future years.

Have students build three-dimensional energy transfer models to represent the varying amounts of energy or matter represented at differ-



passage to themselves or with an aide before being asked to read aloud.

When working on written assignments, allow students to create illustrations and make an oral presentation about their assignment to the teacher or to an aide.

When brochures are produced, partner students with lower reading

or writing skills with more able readers and writers. Provide written materials at appropriate levels, give extra time, or offer assistance of an aide.

Give students the option of making and using notes and practicing what they are going to say for oral presentations such as in Lesson 5. Ask students to summarize the text,

(for example, “puzzle pieces”) in their own words in writing and read their summary to the class.

In Lesson 6, have students dictate articles to an aide, volunteer, or parent and use this as the article they read to the class.

Ask students to investigate a local species that is threatened or endangered by attending a meeting where this species will be discussed. Students should investigate efforts to protect the species (for example, through habitat management, letters to the editor, fundraising) and present their findings to the class. (An Internet search should yield conservation organization names and contact information.) When reading the script

in Lesson 3, have students create costumes or props to represent the characters.

Ask students to add text to the “The Energy Transfer Story: The Higher, the Fewer” script or create a new script.

Have students obtain, review, and report on (orally or in writing) actual Environmental Impact Reports or Timber Harvest Plans.

Ask students to investigate a local

land use issue by conducting Internet research, visiting the specific site, attending hearings, and reading articles and editorials in local newspapers. Working with the teacher or a local volunteer, have students arrange for guest speakers for the class, prepare and ask questions, and write letters of appreciation. Students should write letters to the editor or create sample radio or television public service announcements about what they learn.

ent trophic levels.

Arrange a field trip to a park, forest, lumberyard, or hardware store to help students understand the importance of timber to humans and forest organisms. Invite guest speakers involved in the timber industry,

forest management, or conservation to discuss their roles in resource management and use. Have students develop interview questions. Be sure students develop open-ended rather than closed questions. For example, rather than asking, “Were many trees

cut here?” students should ask, “What are some of the effects of cutting trees in this area?” Have students practice their questioning skills with partners.

## Unit Assessment

# Traditional Assessment

### Description:

The Energy - Pass It On! Unit Assessment is comprised of multiple choice and short answer questions. This test assesses student mastery of academic content standard 6.5.c. through each of the EEI Learning Objects addressed in this unit.

### Instructions:

#### Teacher Instructions:

Distribute the copies of the Unit 6.5.c. Assessment (Unit Activity Masters) to the students and provide one class period to complete. The answer key is provided on page 19-20.

### Suggested Scoring



**Unit Assessment (Activity Master) | Answer Key** *page 1 of 2***Answers to multiple choice questions:**

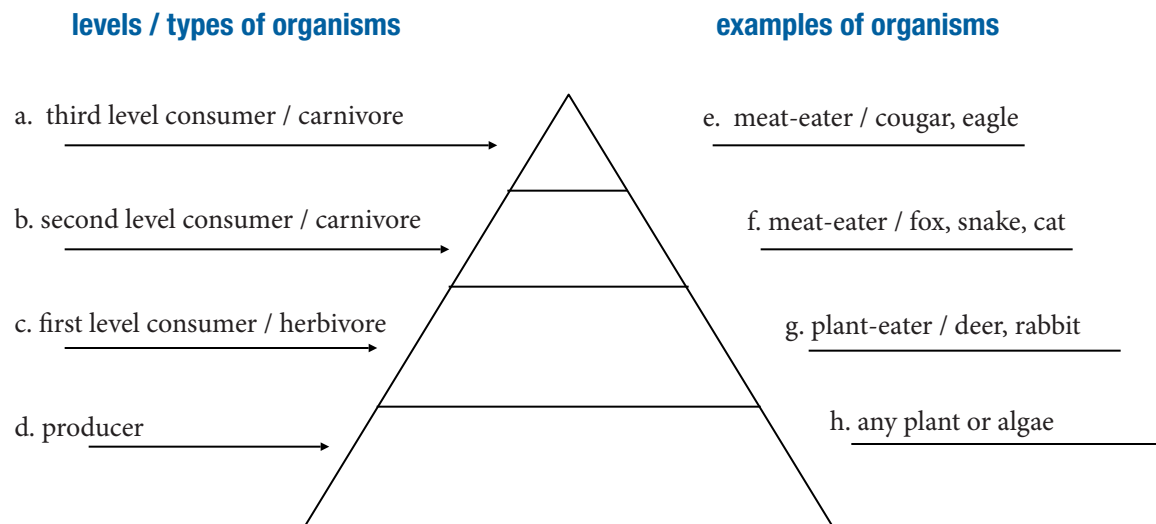
1. d    2. b    3. c    4. d    5. a    6. d    7. b    8. a    9. b    10. b    11. d    12. d    13. b

**Possible answers to short answer questions:**

14. **Sample Answer:** Producers such as plants use energy from the sun to form energy-rich chemicals such as sugars. This is done in the process of photosynthesis. Organisms that feed on other organisms are called consumers. Herbivores are consumers that obtain their energy by eating plants. Carnivores obtain their energy by eating other animals, which may include herbivores. A mountain lion might get its energy by eating a deer, which got its energy by eating plants, which got their energy from the sun through photosynthesis.

15. Label the trophic levels of the energy pyramid below. Use the following terms in your labels in the left column: (Some of lines a-d will have more than one term.)

Sample Answers:



16. If 100,000 units of energy are stored in the grass in the following food chain, how many units of energy would the hawk have?

**Answer:** The hawk would have 10 units of energy.

17. Explain why the hawk has less energy than is found in the grass.

**Sample Answer:** The hawk would have 10 energy units because only about 10% of the energy in a trophic level or step in an energy pyramid is available for the next level or step. This is because each organism uses some of the energy that it takes in, and much is lost to the environment as heat or in waste products rather than being passed on.

Grass=100,000 units, grasshoppers=10,000 units, frogs=1000 units, snakes=100 units, hawk=10 units.

## Unit Assessment (Activity Master) | Answer Key *page 2 of 2*

18. A city needs to widen the road going through a forest to a nearby lake. Name two parts of the road widening process that could affect the lake and forest ecosystem.

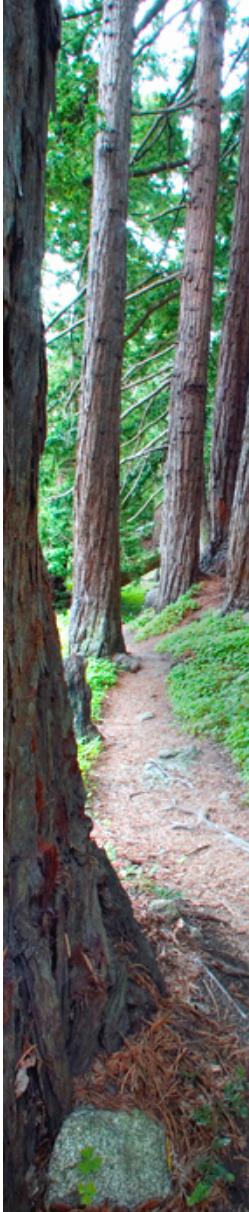
**Sample Answer:** the materials used in the widening of the road, how big (wide) the road is made to be, how long it takes to widen the road, cutting down trees and moving soil, exhaust, noise and vibrations from the machines used in widening the road, etc.

19. Could the widening of the road affect the food/energy pyramid in the lake or in the forest? Explain why or why not.

**Sample Answer:** The food/energy pyramid would be affected by the widening of the road, because as the forest and the lake are changed, the living organisms may be unable to locate food. Consumers in the forest might leave the area because of the noise and vibrations (scared away), or because their habitat is changed (tree was cut down, hillside was leveled). The consumers and scavengers that eat those consumers will also migrate (if they can) to another area, leaving the decomposers in the area with less “food.” The organisms in the lake that are not able to migrate (fish, amphibians), if they are unable to find food, they will die. If the water in the lake changes (water level or water quality) because of soil erosion or use of the lake water by the road widening process, the plants could die, increasing the chances that the rest of the organisms in the lake will die.



## Unit Resources



### Resources for Students

California Institute for Biodiversity. *Cal Alive!* <http://www.calalive.org>

### References for Teachers

Aubry, Keith B., Kevin S. McKelvey, and Jeffrey P. Copeland. In press. Geographic Distribution and Broad-Scale Habitat Relations of the Wolverine in the Contiguous United States. *Journal of Wildlife Management*.

Miller, G. Tyler, Jr. 2007. *Living in the Environment*, 15th ed. Belmont, CA: Brooks Cole Publishing.

Odum, Eugene, and Gary Barrett. 2005. *Fundamentals of Ecology*, 5th ed. Belmont, CA: Brooks Cole Publishing.

Sierra Nevada Ecosystem Project. 1996. *Sierra Nevada Ecosystem Project: Final Report to Congress*. Davis: University of California, Centers for Water and Wildland Resources. <http://ceres.ca.gov/snep/pubs/index.html>

### Instructional Support

Agencies, institutions, and organizations throughout California have identified themselves as providing programs and materials that support this unit. Links to these resources are available at: [http://www.calepa.ca.gov/Education/EEI/instructional\\_support.html](http://www.calepa.ca.gov/Education/EEI/instructional_support.html)



## Lesson 1



# What Is a Population?

The study of ecology involves investigating ecosystems, organisms in ecosystems, and the exchange of energy and nutrients among organisms and their environments. In this lesson, students learn that the way the term population is used in ecological studies is somewhat different from the way it is used in everyday language.

To understand how populations of organisms function in ecosystems, students must understand what a **population** is.

Students read *California Connections* about the natural history of the wolverine in the Sierra Nevada region

of California. Through the story's discussion of the populations of various organisms, students are introduced to the term "population." The students use various resources, including dictionaries and their textbooks, and conduct interviews to develop an

understanding of the term. This understanding provides the basis for the rest of the unit, which explores how populations of organisms are categorized by the functions they serve in **ecosystems**.





## Background

By the sixth grade, most students are familiar with the term “population,” but may not understand its use in the field of ecology. Many people define population from a human perspective, that is, how many people live in a place. Dictionary definitions will vary slightly. The scientific definition is more precise and somewhat different from most dictionary definitions.

Merriam-Webster’s Online Dictionary (2006-07) defines population as: (1a) the whole number of people or inhabitants in a country or region; (1b) the total of individuals occupying an area or making up a whole; (2) the act or process of populating; (3a) a body of persons or individuals having a quality or characteristic in common; (3b1) the organisms inhabiting a particular locality; (3b2) a group of interbreeding organisms that represents the level of organization at which speciation; (4) a group of individual persons, objects, or items from

## Learning Objective

Define a population.



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which samples are taken for statistical measurement.

In biological or ecological studies, a population is generally considered a group of individuals of a given species living in a given area at a given time,

or the number of individuals of a species living in an area at a given time. The scientific meaning has three parts: (a) the species, (b) the area or place, and (c) the time (when). The term can refer to a number or a group of **organisms**. Note: Elementary texts often omit the time part of the definition, but it is important for students to understand that populations change with time.

In addition to animals, ecosystems have populations of plants, bacteria, and fungi.

Scientists categorize populations of organisms by the functions they serve; for instance, are they producers, consumers, or decomposers?

## Key Vocabulary

**Population:** (a) the number of a particular type of organism living in a place at a given time; (b) the organisms themselves.

**Ecosystem:** Groups of interacting and/or interdependent biotic and abiotic components or factors in a specific area.

**Habitat:** The place where an organism lives and meets its needs.

**Natural systems:** The interacting, interdependent components, processes, and cycles among organisms and their habitats.

**Organism:** A living plant, animal or other life form capable of metabolic activity and reproduction.



© Kip Evans Photography

Caption to come

# Toolbox



## Summary of Activities

Students compare and contrast the definitions of the term population as given by: (a) a dictionary, (b) their science text or teacher, (c) classmates and parents, and (d) background information provided in this lesson.



## Instructional Support

See Unit Resources, page 21

### Prerequisite Knowledge



- Students should be able to use a dictionary and understand that dictionaries often give several definitions for a word.
- Students should understand the sixth-grade science content standards 5.a. (energy transfer through photosynthesis and food chains) and 5.b. (food webs and decomposition).

### Advanced Preparation

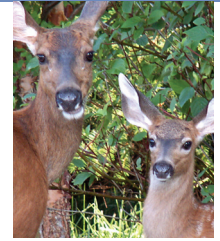


#### Make copies:

Make copies as indicated in the Activity Masters section below.

#### Produce transparencies:

Make transparencies of “Wolverine in Its Habitat,” “Classroom Populations,” and “Populations in Nature.”



## Materials Needed



### Student dictionaries:

Approximately six per class

### Activity masters:

See below

## Visual Aids



### Transparencies:

- Wolverine in Its Habitat, page 99
- Classroom Populations, page 100
- Populations in Nature, page 101-102

## Duration



### Preparation time:

15 min.

### Instructional time:

60 min.



## Safety Notes

None

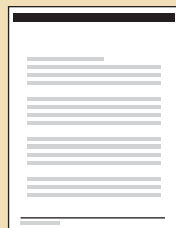
## Activity Masters



### Where Are the Wolverines - Part 1

Page 72

One per student



### What Is a Population?

Page 73

One per student

# Procedures

## Step 1

Use the **Wolverine in Its Habitat** (Lesson 1 Visual Aid) transparency to introduce the “mystery animal.” Ask students if anyone can identify this animal. Discuss their responses. Tell them the animal is a wolverine.

## Step 2

Read Part 1 of *Where Are the Wolverines?* After reading Part 1, note that it mentioned the populations of several organisms such as the wolverine, the deer, and the sheep. Point out those organisms on the transparency.

## Step 3

Read the following sentences to the students and ask them what is meant by the term population in each example. (In the first example, population refers to a number of people even though it does not specifically say people. In the second example, it refers to the actual group of people. In the third example, it refers to the number of deer.)

- The population of the United States is over 300 million.
- The population of the city was exposed to the dangerous chemical.
- The population of deer has increased since the wolves were removed.

Discuss the fact that the word population has somewhat different meanings in each of the above examples, and that scientists use precise meanings of words.

## Step 4

Distribute the Activity Master **What Is a Population?** (Lesson 1 Activity Master). Review the instructions and provide time for students to look up dictionary meanings of “population.” (On the following day, ask students to share the responses given by parents and others.).

## Step 5

Provide the students with the scientific definition of the word “population.” Be sure to include the three aspects of the definition: (a) the number of a particular type of organism (what), (b) in a place (where), (c) at a given time (when). Ask the students to identify the populations shown on the **Classroom Populations** (Lesson 1 Visual Aid) and **Populations in Nature** (Lesson 1 Visual Aid) transparencies. Guide a discussion about the scientific meaning of the word “population.”

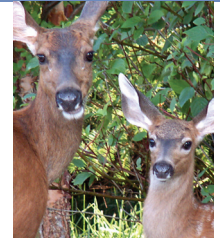
## Step 6

Ask several students to state the populations in the classroom (humans, fish, hamsters/rabbits).

## Step 7

Revisit the *Where Are the Wolverines?*—Part 1 and discuss the various populations mentioned (*wolverines, hoary marmots, deer, mice gophers, pikas, grizzly bears, humans*).





## Lesson Assessment

# Instructions

### Description:

The EEI Learning Objective for Lesson 1 states that students will define a population. Assessment of student learning will be determined through the use of a writing assignment that will include two questions and a writing prompt.

### Instructions:

#### Teacher Instructions:

Write the following assessment questions and writing prompt on the board. Have students copy this information on a piece of paper or on a page in their reflection journals. Instruct students to answer the questions thoroughly. Collect their papers or journals when done.

#### Student Instructions:

Lesson 1: What is a Population?

On a piece of paper (or in your reflection journal) answer the following two questions and write a one sentence response to the writing prompt. The point value for each part of this assessment is provided. When finished submit your work to your teacher for scoring.

#### 1. List the three parts of the scientific definition of the word “population.”

(3 points)

#### 2. How is the scientific definition of the term population different from what you thought it was before this lesson?

(2 points)

#### 3. Write a sentence that demonstrates your understanding of the scientific meaning of the word “population.”

(5 points)

### Suggested Scoring

#### Scoring Method:

Students will submit work to teacher who can score or pass out to class to peer-score. The total possible point value is 10 points.

#### 1. List the three parts of the scientific definition of the word population.

(3 points)

Answer: the species (what organism),  
the area/place/location (where), the  
time (when)

#### 2. How is the scientific definition and use of the term population different from common usage of the word?

(2 points)

Example: Many people think of population as how many people (a number) are in a certain place. Scientists are more specific and don't use numbers. They talk about the specific species of organisms, the location where the species is observed and when they were observed.

#### 3. Write a sentence that demonstrates your understanding of the scientific meaning of the word “population.”

Example: Our class was studying ecosystems and visited Walden Pond last Wednesday and saw Canadian Geese.

(5 points)



## Lesson 2

# Making a Living

Over two class periods, teachers use a combination of direct instruction and research to guide student learning about the functions of various organisms in different ecosystems. Students learn terms that scientists use for the functions of organisms in an ecosystem (for example, producer, consumer, herbivore, carnivore, omnivore, decomposer, and scavenger).

Students use their knowledge of the Sierra Nevada Mountains, the “Ecosystem Background Information” Activity Master, their textbooks, and other references to identify organisms and the functions they serve in California ecosystems. As a result,

students learn that all ecosystems have organisms that fill similar roles. Class discussions enable students to see that humans depend on ecosystems and are consumers of food, energy, and materials that come from various ecosystems. Students demon-

strate their learning by completing a study guide and creating drawings (in class and as homework) that identify common examples of the organisms that fill the functions or jobs in different ecosystems.





## Background

There are certain functions or roles that organisms must fill to keep any ecosystem healthy and working properly. Different organisms perform similar functions in different ecosystems. There are always **producers**, **consumers**, **scavengers** and **decomposers**, though the types and numbers vary from ecosystem to ecosystem.

Virtually all ecosystems function in much the same manner. The solar energy captured in the chemical bonds inside producers (plants and certain bacteria) is transferred to consumers (animals) when the plants are eaten. Chemical reactions inside the bodies of animals release that energy, as needed, to carry on the basic life processes necessary for growth and survival. Certain animals consume plants directly to obtain this necessary energy; other animals consume other animals for it. Specific designations of species that are consumers are used when biologists talk about the primary source of energy in an animal's diet. If the animal primarily consumes plants, it is an **herbivore**. If meat is the primary source of energy in a consumer's diet, it is a **carnivore**.

## Learning Objectives

Give examples of the functions (producer, consumer, and decomposer) populations of organisms serve in an ecosystem.

Identify humans as consumers within ecosystems.



© Kip Evans Photography

If the animal's diet is comprised of whatever consumable material it can find at a particular time, plant or animal, it is considered an **omnivore**. Humans are omnivorous by nature, although some of us have made dietary choices based on philosophical or health reasons.

Some plants, like the Venus flytrap are carnivorous but, none of these are native to California.

Scavengers and decomposers play critical roles in the transfer of energy and matter in ecosystems. Scavengers primarily eat dead and decaying plant and animal matter, consuming animals that have died from other causes and materials that other organisms may have discarded. The role in decomposition played by **bacteria**, **fungus** (**fungi**), and various insects makes the nutrients in dead and decaying organic matter available to other parts of the ecosystem. Some organisms that are decomposers can pose a health threat to other organisms, including humans, if their populations become very large others may become parasites.

## Key Vocabulary

**Bacteria:** One-celled organisms with no nucleus; many are important decomposers.

**Carnivore:** Organism whose primary food source is other animals.

**Consumer:** Organism that obtains energy and materials by eating other organisms.

**Decomposer:** Organism that gets its energy and materials by breaking down (decomposing) the remains of

dead organisms and absorbing the nutrients.

**Fungus (fungi):** A group of organisms, including mushrooms and yeasts, that obtain their energy and nutrients from dead organic matter.

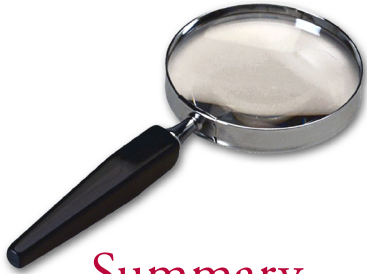
**Herbivore:** Organism whose primary food source is plants or other producers.

**Omnivore:** Organism that eats both plants and animals.

**Producer:** Organism such as a plant or alga that uses light energy or chemical energy to produce food (sugar) from inorganic chemicals.

**Scavenger:** Organism that eats dead organisms.

# Toolbox



## Summary of Activities

Students learn the functions of various organisms in the Sierra Nevada ecosystem. They learn terms scientists use, conduct research on the functions of organisms, and demonstrate their learning by completing a study guide identifying examples and answering questions about organisms and their functions in a specific ecosystem.



## Instructional Support

See Unit Resources, page 21

### Prerequisite Knowledge



- Students should know that energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.
- Students should also know that matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.
- Students should be able to use books or the Internet to obtain information about biomes or ecosystems.

### Advanced Preparation

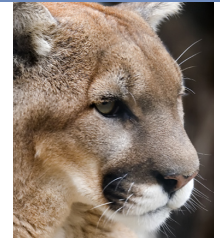


#### Make copies:

Make copies as indicated in the Activity Masters section below.

#### Create transparencies:

Make transparencies of “Making a Living #1,” “Making a Living #2,” and “Organisms and Their Functions.”



## Materials Needed



### Class Supplies:

Blank paper, colored pencils or crayons

### Activity masters:

See below

## Visual Aids



### Transparencies:

- Wolverine in Its Habitat, page 99
- Making a Living #1, page 103
- Making a Living #2, page 104
- Organisms and Their Functions, page 105

## Duration



### Preparation time:

30 min.

### Instructional time:

45 min.



## Safety Notes

None

## Activity Masters



### Making a Living Study Guide

Page 75

One per student



### California Ecosystem Information

Page 76

One per student

# Procedures

## Step 1

Project the **Wolverine in Its Habitat** (Lesson 2 Visual Aid) transparency and introduce the idea that different organisms in the habitat do different things. Emphasize that different organisms have different roles or functions. Ask students, “What is the main job of the plants?” (*Plants are producers that use water, carbon dioxide, and sunlight to produce sugars and starches (food) for other organisms.*) Ask students, “What are the functions or jobs of animals?” (*Consumers, decomposers, scavengers.*)

## Step 2

List the following terms on the board: “producer,” “consumer,” “herbivore,” “carnivore,” “omnivore,” “decomposer,” “scavenger.” Ask students for a brief definition of each and record those definitions. If students do not know what a word means, leave a blank for the definition.

## Step 3

Draw the following chart on your board.

Role or Function	Field or Forest Plant or Animal	Pond Plant or Animal
<b>Producer:</b>		
<b>Consumer (herbivores):</b>		
<b>Consumer (carnivores):</b>		
<b>Consumer (omnivores):</b>		
<b>Consumer (scavengers):</b>		
<b>Decomposer (bacteria and fungi):</b>		



### Step 4

Show the transparencies **Making a Living #1** (Lesson 2 Visual Aid) and **Making a Living #2** (Lesson 2 Visual Aid). Ask students to help complete the chart on the board by identifying the organisms that serve various functions in these natural communities (forests and ponds), noting that most decomposers such as bacteria and most fungi are too small to be seen in the illustrations. Complete or revise the class definitions in Step 2.

### Step 5

Stress the fact that all natural communities have organisms that serve these functions; that is, all have producers, consumers, scavengers, and decomposers. Ask students for additional examples of organisms that serve these functions. List their examples under the terms written on the board. Point out that more than one term may apply to any particular organism. For example, a deer is both a consumer and an herbivore.

### Step 6

Ask where people fit on the list. (*People are consumers and omnivores. Students may ask about vegetarians. While some people may choose not to eat meat, as a species, humans are omnivores.*).

### Step 7

Use the **Organisms and Their Functions** (Lesson 2 Visual Aid) transparency to review the functions of organisms found in ecosystems.

### Step 8

Distribute and discuss the **Making a Living Study Guide** (Lesson 2 Activity Master). Explain that students are research the functions of organisms in an ecosystem, record their information, and answer the questions on the study guide. They should also include drawings of organisms that serve different functions (producers, consumers, scavengers, and decomposers) in the selected ecosystem.

### Step 9

Distribute the **California Ecosystem Information** (Lesson 2 Activity Master) chart. Assign or let students select one of the ten listed California ecosystems to research. Students should begin their research and start working on their study guides in class. They may consult their textbooks, the library, or the Internet if they need additional information. As homework, have students complete their study guides and produce their drawings and submit to teacher the following day.

## Lesson Assessment

# Instructions

### Description:

The EEI Learning Objective for Lesson 2 states that students will give examples of the functions (producer, consumer, decomposer) populations of organisms serve in an ecosystem. Assessment of student learning will be determined as students complete the **Making a Living Study Guide** (Lesson 2 Activity Master). In the process students will identify common examples of the organisms that fill the functions or jobs in an ecosystem.

### Instructions:

#### For teacher:

Distribute and discuss the **Making a Living Study Guide**. Explain that students will begin their research in class on the functions of organisms in an ecosystem, record their information, and answer the questions on the study guide. Study Guide may be completed as homework.

### Suggested Scoring

#### Scoring Method:

Total Point Value: (30 points).

Use the point values listed on the **Making a Living Study Guide** to assess students' work. Students can also peer-and self-assess.





## Making a Living Study Guide Sample Answers (Lesson 2 Activity Master)

My ecosystem type is: *Oak Woodland*

(1 point)

Role or Function		Examples of Typical Organisms
Producers		<i>Trees: Oaks</i> <i>Flowers: Indian Paintbrush</i> (2 points)
Consumers	Herbivores	<i>Black-Tailed Deer</i> <i>Anna's Hummingbirds</i> (2 points)
	Carnivores	<i>Mountain Lions</i> <i>Lizards</i> (2 points)
	Scavengers	<i>Turkey Vultures</i> <i>Coyotes</i> (2 points)
	Omnivores	<i>Opossums</i> <i>Skunks</i> (2 points)
Decomposers		<i>Fungi</i> <i>Worms</i> (2 points)

Source(s) of information: *Name of sixth grade science book (Publisher), Internet (<http://www.almaden.ibm.com/almaden/almaden/environs/habitats.html>), encyclopedia (name), other books or source (provide name)* (2 points)

Questions:

1. What would happen to the consumers if there were no producers? (5 points)

*They would die. Some consumers are herbivores that eat plants; others may be carnivores that eat animals that may eat plants; or, other may be omnivores that eat both plants and animals. All consumers depend on plants as the original source of their energy.*

2. What would happen if there were no decomposers? (5 points)

*Decomposers are organism that gets energy and materials by breaking down the dead plants and animals and their waste. Then they and absorb their nutrients.*  
*If decomposers did not exist, the plants would not get nutrients they need to survive, and dead matter and waste would pile up. If there were no plants, consumers would not have a source of food.*

3. Why are people considered to be consumers? (5 points)

*People are consumers because they obtain energy and materials by eating other organisms like plants and/or animals.*



A photograph of a forest with sunlight filtering through the trees. The sun is low in the sky, creating a warm, golden glow that illuminates the forest floor and the trunks of the trees. The trees are tall and slender, with some fallen logs on the ground. The overall atmosphere is peaceful and natural.

## Lesson 3

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# The Higher, the Fewer

**E**nergy is not transferred equally in an ecosystem and the amount of available energy varies at the level of consumption (primary, secondary, and tertiary consumers.) In Lesson 3, students learn about trophic levels (a step in the food chain or food web) and the organisms that are involved at the various levels of consumption.

An energy pyramid depicting levels of consumption introduces the concept of energy transfer.

Students participate in a scripted role-playing activity that demonstrates that while energy is passed through the ecosystem in food chains

and food webs, only about 10% is passed on to the next [trophic level](#). During this activity, some students read parts, other students use graph paper squares to represent the quantities of energy transferred at different trophic levels, and the rest of the class

serves as the audience. The activity builds a foundation for understanding that populations of organisms can be categorized by the functions they serve in an ecosystem.





## Learning Objective

Explain how energy is transferred in an ecosystem and how the amount of available energy varies at the level of consumption (primary, secondary, and tertiary consumers).



10% of the energy at each level is available to pass on to the next trophic level; 90% is used by the consumers themselves or lost to the environment as heat or waste products. Processes such as the contraction of muscles used in pumping blood, breathing, and moving use chemical energy from foods and give off heat. For example, warm-blooded animals such as mammals and birds use a lot of energy to maintain their body temperatures. Food waste contains undigested food that still has significant amounts of chemical energy in it.

Consumers at the top of an energy pyramid, as a group, have much fewer sources of energy available to them than those consumers closer to the bottom. Thus, in healthy ecosystems, there are relatively few top consumers. Eventually, the remaining amount of useful energy cannot support another level. That is why energy flow in an ecosystem is depicted in the shape of a pyramid. The energy that enters a community and moves up through the food chain is ultimately lost to the surroundings as heat.

## Background

When light from the sun reaches Earth, it is either reflected or absorbed. Some scientists estimate that plants and other producers (such as algae) absorb about 1% of incoming solar energy. **Producers** convert light energy into sugars and starches through the process of photosynthesis. Plants are the primary source of matter and energy entering most food chains, linking the survival of consumers with producers.

The steps in the food chain are sometimes referred to as trophic

levels (from the Greek root *troph*, for food). The first **trophic level** consists of producers. Herbivores, or **primary consumers**, occupy the second trophic level. Animals that eat herbivores are secondary consumers and form the third trophic level. Animals that eat primary and **secondary consumers** are **tertiary consumers**, and so on up the food chain.

**Energy pyramids** are graphic models of energy flow in a ecosystem. The pyramid presents a picture of the amount of available energy that enters each trophic level. Only about

## Key Vocabulary

**Consumer:** Organism that obtains energy and materials by eating other organisms.

**Energy pyramid:** Graphic model showing that about 90% of the energy in organisms at a given trophic level is lost as the organisms are consumed by organisms at the next trophic level.

**Producer:** Organism such as a plant or alga that uses light energy or chemical energy to produce food (sugar) from inorganic chemicals.

**Primary consumer:** In a food chain, the first consumer; an herbivore.

**Secondary consumer:** The second consumer in a food chain; an organism that feeds on a primary consumer or herbivore.

**Tertiary consumer:** The third consumer in a food chain; an organism that feeds on a secondary consumer.

**Trophic level:** A step in a food chain or food web; producers are the first trophic level, herbivores the second, carnivores that feed on herbivores are the third, and so forth.

# Toolbox



## Summary of Activities

Students use energy pyramids and role-playing to learn about energy flow in a community. They start with 10,000 energy units, and as they read a script, they observe energy is lost at each trophic level in a food chain.



## Instructional Support

See Unit Resources, page 21

### Prerequisite Knowledge



- Students should know that energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food chains and food webs.
- Students should also know that matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.

### Advanced Preparation



#### Make copies:

Make copies as indicated in the Activity Masters section below. Also, make one copy per student of the **Mountain Lion Energy Pyramid** (Lesson 3 Visual Aid) transparency. *(optional)*

#### Highlight scripts:

Highlight individual actors' parts on their copies of **The Energy Transfer Story: The Higher, the Fewer** (Lesson 3 Activity Master).

#### Make energy units:

Cut apart one page of the **2000 Energy Units** (Lesson 3 Activity Master) as specified in Step 3 of the Procedure.

#### Create identification signs:

Make a sign identifying each of the six parts in the role-play. Glue each illustration provided in "Steps in the Energy Pyramid" onto a sheet of cardstock. Label each sign: narrator, sun, producer (grass), primary consumer (rabbit), secondary consumer (coyote), tertiary consumer (wolverine). Punch holes in the corners and attach string so students can wear the signs around their necks.



## Materials Needed



### Cardstock:

Six sheets

### String:

Six 3-foot lengths

### Activity masters:

See below

## Visual Aids



### Illustrations:

Steps in the Energy Pyramid,  
page 106 - 108

### Transparency:

Mountain Lion Energy Pyramid,  
page 109

## Duration



### Preparation time:

15-30 min.

### Instructional time:

45 min.



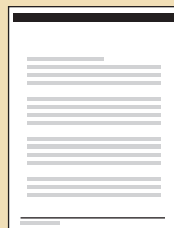
## Safety Notes

None

## Activity Masters



**The Energy Transfer Story:  
The Higher,  
the Fewer**  
Page 77  
Six per class



**2,000  
Energy Units**  
Page 79  
Six per class



**Energy Pyramid  
Assessment**  
Page 80  
One per student

# Procedures

## Step 1

Use the **Mountain Lion Energy Pyramid** (Lesson 3 Visual Aid) transparency to illustrate and discuss the various roles organisms play in an ecosystem and the loss of energy at each trophic level. Guide students in observing the titles of the levels on the pyramid (*producers, primary consumers, secondary consumers, tertiary consumers*) to emphasize that: (a) different organisms eat different foods (that is, have different energy sources), (b) at each trophic level there is less energy available, and (c) at each trophic level, there are fewer individual organisms. (*Note: The transparency also can be used as a student worksheet.*)

## Step 2

Write the following questions on the board. Review the questions with the class. Explain that students will be participating in a role-play. During the role-play, they should listen for clues that answer these questions.

- What happened to most of the energy that reached the plant? (*99% was reflected; only 1% was stored through photosynthesis*)
- In what form did the plants store energy? (As chemical energy in molecules such as glucose (*sugars*).)
- About what percentage of the energy taken in by the consumers was available for the next level of consumer? (*About 10%*)
- What happened to the energy that was not passed on to the next trophic level? (*Organisms used it for life processes such as moving, breathing, digesting, growing, capturing food, and finding shelter. Some was also lost with waste products.*)

## Step 3

Prepare students to participate in the energy transfer role-play. Select six students for reading parts and assign their roles. Give each reader the appropriate role sign and a highlighted script of **The Energy Transfer Story: The Higher, the Fewer** (Lesson 3 Activity Master). Select five students to represent the energy use. Pair one of these students with each of the readers, except the narrator, and give them prepared graph paper as follows:

- Narrator: no graph paper
- Sun: 5 full sheets of graph paper (10,000 energy units)
- Grass: 100 squares from graph paper (100 energy units)
- Rabbit: 10 squares from graph paper (10 energy units)
- Coyote: 1 square from graph paper (1 energy unit)
- Mountain lion: “mountain lion square” from graph paper (0.1 energy units)

Instruct participating students to line up in order at the front of the room holding their sign and energy units.



### Step 4

Ask the narrator to begin reading the script. Ask the other readers to read their parts when prompted; their partners should hold up their energy units as appropriate. Remind the rest of the class to listen attentively and be prepared to discuss energy transfer.

### Step 5

As time permits, pose the following reinforcing questions at appropriate points during or after the role-play:

- Plant: “Can anybody name other producers?” (Call on two or three students to name other plants such as pine trees, bushes, or oak trees.)
- Herbivore: “Can anybody name another first level or primary consumer?” (Call on two or three students to name other herbivores such as insects, deer, mice, and squirrels.)
- Second-level consumer: “Can anybody name another second level consumer or secondary consumer?” (Call on two or three students to name other carnivores such as mountain lions, snakes, hawks, and some insects.).

## Lesson Assessment

# Instructions

### Description:

The EEI Learning Objective for Lesson 3 requires students to explain how energy is transferred in an ecosystem and how the amount of available energy varies at the level of consumption (primary, secondary, and tertiary consumers). Students will demonstrate their learning using the **Energy Pyramid Assessment** (Lesson 3 Activity Master).

### Instructions:

#### For teacher:

Distribute the **Energy Pyramid Assessment** as a class quiz or homework.

### Suggested Scoring

#### Scoring Method:

The **Energy Pyramid Assessment** answer key is provided on page 43.





## Energy Pyramid Assessment (Lesson 3 Activity Master) | Answer Key

Use the Word Bank below to complete the sentences in Questions 1-7: (14 points)

### Word Bank

consumer	producer	tertiary consumer
energy pyramid	secondary consumer	trophic level
primary consumer		

1. An organism that obtains energy and materials by eating other organisms: consumer
2. Third consumer in a food chain; an organism that feeds on a secondary consumer: tertiary consumer
3. An organism such as a plant or alga that uses light energy or chemical energy to produce food (sugar) from inorganic chemicals: producer
4. The second consumer in a food chain; an organism that feeds on a primary consumer or herbivore: secondary consumer
5. A step in a food chain or food web; producers are the first level, herbivores the second, carnivores that feed on herbivores are the third, and so forth: trophic level
6. In a food chain, the first consumer; an herbivore: primary consumer
7. A model that shows that about 90% of the energy in organisms at a given trophic level is lost as the organisms are consumed by organisms at the next trophic level: energy pyramid
8. Draw the energy pyramid including: grass, rabbit, coyote, and mountain lion. Label each by their function: producers, primary, secondary, and tertiary consumers. And, label the three trophic levels; (6 points)  
*The pyramid should have four levels—the base should show the grass and have it labeled as a producer; the next level up should have rabbits and the rabbits should be labeled as primary consumers; the next level up should show a few coyotes and the coyotes should be labeled as secondary consumers; and the top of the pyramid should have a single mountain lion labeled as the tertiary consumer.*
9. Answer the following question on the bottom of the page on which you draw the pyramid: About what percentage of the energy taken in by each of the consumers is available for the next level of consumers? (5 points)  
*About 10%*





## Lesson 4

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# It Is All Connected

In order to understand how organisms function in an ecosystem, students must understand how altering ecosystems affects those organisms. To this end, it is important to introduce humans as consumers of ecosystem products.

When people alter ecosystems, they affect the organisms that live there. Intended changes, such as cutting of trees or building roads, often have unintended consequences. Cutting trees may result in loss of food or shelter for wildlife. Building roads

may cause runoff and loss of stream habitat.

As people have moved into the Sierra Nevada Mountains, they have affected many of the organisms living there. In Lesson 4, students view before and after pictures of for-

est ecosystems that are being used (consumed) by humans. Discussions focus on how humans consume goods (matter) produced by natural systems and the types of byproducts generated by their consumption.





## Background

The habitat in the Sierra Nevada Mountains has changed significantly over the past 200 years. The most obvious changes are due to logging. Logging is done for a number of reasons important to people: for timber; to clear land for roads, freeways, and housing; for mining, recreation, agriculture, and more. These forms of consumption have many effects—some obvious and some unintended—on wildlife in an ecosystem.

In the past, there was little regulation of logging, but today California has many regulations intended to ensure future supplies of wood and to reduce the effects of logging on forest organisms.

Sometimes logging practices call for clear-cutting, while selective cutting is used at other times. These different timber harvesting practices have different effects on the ecosystem. With clear-cutting, where all trees in a stand are removed at once, logging equipment is brought in only every 40 to 60 years, allowing time for habitat recovery. This practice is sometimes more profitable.

## Learning Objective

Identify and describe byproducts generated by the human consumption of goods (matter) produced by natural systems (ecosystems).



Selective cutting means removing individual trees or groups of trees from a forest stand. This method leaves a greater diversity of habitat but involves more frequent re-entry with

heavy equipment. Sometimes trees left for future harvesting are subject to being blown down because they have lost the protection of the trees surrounding them.

In addition to the direct effects of forest practices, some of these practices produce **byproducts** that influence the transfer of matter through natural systems. For example, when trees are cut for lumber products, tree limbs and tops are generally left in the forest where they may be a fire hazard or they may be compressed to form erosion-reducing ground cover.

Organisms are influenced both directly and as a result of the byproducts and influences of **human practices**. They generally respond to changes in the ecosystems in which they live in one of three ways: they move, adapt, or die. For instance, if the trees in a forest are cut down and no longer offer protection, animals might move to new forests. However, this option is not available to plants, and the newly arriving animals face competition from those already living in their new habitat.



## Key Vocabulary

**Byproduct:** An incidental product that results from human or natural system processes (e.g., materials remaining after manufacturing).

**Human practices:** The ways that individual people, communities and societies do things.

**Land use:** How a piece of land is used such as forestry, farming, manufacturing, habitat protection

# Toolbox



## Summary of Activities

Students view before and after pictures of forested areas where human practices brought about changes. They discuss the changes in the ecosystems and the effects of those changes on the ecosystem. They also identify some of the unintended byproducts of logging practices.



## Instructional Support

See Unit Resources, page 21

### Prerequisite Knowledge



- Students should understand that organisms are interdependent.
- They should be aware that food web relationships demonstrate the interdependence among organisms.
- They should be able to identify examples of products made from wood logged in the Sierra Nevada Mountains.

### Advanced Preparation



#### Produce transparencies:

Make the **Before and After** (Lesson 4 Visual Aid) transparencies

**Materials Needed**

Transparency of **Before and After**

**Visual Aids****Transparencies:**

Before and After, page 110

**Duration****Preparation time:**

20 min.

**Instructional time:**

45 min.

**Safety Notes**

None

**Activity Masters**

No activity masters are used in this lesson.



# Procedures

## Step 1

Using the **Before and After** (Lesson 4 Visual Aid) transparency, show a “before” image of a natural forest or forested area. Have students identify some of the organisms that might live in such a place and what these organisms use for food. List the suggestions on the board. Be sure students include both plants and animals. Ask prompting questions to review food chain and food web concepts.

## Step 2

Display “after” images of a clear-cut forest and selectively logged forest using the **Before and After** transparency. Ask students what effects each method of logging may have on the plants and animals that naturally occurred in the area. Use prompting questions to stretch students to thinking beyond the immediate and obvious, such as “What might be happening downstream from this scene?” and “What alternatives might the animals living in this area have?” Discuss the advantages and disadvantages of each logging method.

## Step 3

As a class, discuss wants versus needs in terms of consumption of forest resources. Ask students, “What alternatives do people have when it comes to using forested areas?” “What alternatives do plants and animals have when facing forest development?” (*People can be selective about where, what, and how much they build. Plants and animals have fewer alternatives, often summarized as move, adapt, or die.*) Discuss each of the following examples.

- freeways and trains to move through scenic areas (*Trains can move more people without using as much land.*)
- farming and ranching (*Mountain and forest land is generally not good for growing many crops, but it may be less expensive than good farmland. Using other farmland might raise the price of some products.*)
- ski slopes (*There are many other forms of recreation that do not require the cutting of trees and installation of roads and buildings in the mountains.*)
- development of housing or shopping centers (*This building can be done elsewhere, but then that land would be altered, thereby affecting the organisms that live there.*)
- building a golf course (*Locating golf courses elsewhere would reduce the effects on the forests, but golfers would have to travel farther to golf. Discuss whether people need to have their favorite form of exercise available to them nearby.*)



### Step 4

Write the following land-use changes on the board:

- build a mountain resort that includes tennis courts, an Olympic swimming pool, a game room, a hotel, restaurant, parking garage, and snowmobile rentals
- forbid logging in an area where endangered species live
- build a summer cabin development in a forest, including access roads and a sewage treatment facility

Organize the students into teams of four or five. Assign one scenario to each team. Several teams can work on the same scenario.

Give students 15 minutes to discuss and take notes on: (a) what resources would be consumed as a result of the land-use changes, (b) how the changes would affect plants in the area, and (c) how the changes would affect animals in the area.

### Step 5

Introduce and discuss the concept that byproducts result from the human consumption of goods (matter) and that the effects of these byproducts on natural systems may be beneficial, detrimental, or neutral.

### Step 6

As a class, have the students review the scenarios, then identify and describe the byproducts of each land use change. Write the byproducts on the board next to each of the land-use changes.

# Lesson Assessment

## Instructions

### Description:

The EEI Learning Objective for Lesson 4 requires students to identify and describe byproducts generated by the human consumption of goods (matter) produced by natural systems (ecosystems). Students will demonstrate their learning by writing two questions that they, as a local citizen, would ask an individual or corporation petitioning for (requesting) a land use change in their neighborhood area.

### Instructions:

#### For teacher:

Write the following instructions on the board and have students copy them onto a piece of paper or into their reflection journals: “Imagine a company that would like to use a part of the land in your neighborhood in a way that is different from how it is being used now. Describe that company and what it wants to do with or on the land. Write two questions that they would ask a company seeking permission to change how local land is going to be used in their neighborhood. Your questions should ask for information about byproducts and possible effects on the local natural systems.

### Suggested Scoring

#### Scoring Method:

Answers will vary. Accept any reasonable answers. Each question must identify: The type of company and potential land-use change, discuss possible byproduct(s) that would result from the change; and, identify a possible effect on the local natural system.

Possible score for each sentence: Two points each for land-use change; possible byproduct(s) that would result from the change; and, a possible effect on the local natural system. Total point value: **(12 points)**

#### Examples:

*(A paper company is asking permission to remove trees from a local hillside). When your company removes the trees near the river the process may result in a great deal of compressed soil? How will you prevent the change in the soil erosion around the river?*

*(A hotel chain would like to build summer cabins by a lake). How many cabins does your company plan to build? How will you take care of the trash made by the visitors so that the local wildlife stay healthy?*







## Lesson 5



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# Cause and Effect?

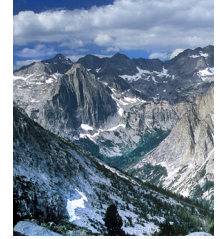
Students have learned how human-caused changes in ecosystems affect the organisms living there. This lesson provides students the opportunity to apply their knowledge about how human practices may have caused changes in the wolverine's habitat.

Students review the natural history of the wolverine and read Part 2 of *Where Are the Wolverines?* In groups, they study fragments of information that describe one human use of the ecosystem in which wolverines once lived. Students write a brief sum-

mary of their group's information and present their piece of the puzzle to the class. They discuss which changes may have had a role in the decline of the wolverine population. Students complete a study guide further exploring the causes and effects of

human practices on natural systems. Finally, they discuss human actions, their unintended consequences, and the importance of examining possible effects before making changes in an ecosystem.





Ranchers set out poison to kill wolverines and any other predators that might attack livestock. Wolverines fed on animals, such as fox and beaver, caught in traps. Trappers also set out poison bait to kill wolverines that raided their traplines. Evidence suggests that poisoning by ranchers and trappers may have been a main cause of the loss of the wolverine population in the Sierra, but other factors were also important.

## Background

Over the past 200 years, numerous and varied changes have occurred in the natural habitat of wolverines in California. Those changes coincided with the decline in the wolverine's population. Since the habitat changed so much and for so many different reasons, one cannot say that any single change caused the decline in numbers of wolverines. However, changes in or loss of habitat cause most extinctions.

The influx of people into the Sierra Nevada Mountains in the late 1800s affected the populations of prey species such as deer, a mainstay of the wolverine diet. Just what the net effect was is not easy to determine. While the new settlers certainly killed deer

for food, they also killed animals such as mountain lions that competed with wolverines. In some areas, logging that opened up the forest may have increased deer populations by creating new areas for preferred foods such as grasses.

Wolverines lived primarily in higher elevations where people have had less influence on the environment. At these elevations, the scarcity of food for a large carnivore meant that wolverines needed to range over a large area to meet their needs. As roads, ski slopes, and settlements fragmented their habitat, it became increasingly difficult for wolverines to find food while avoiding humans.

In the 1800s, ranchers began grazing sheep in the higher elevations.

## Learning Objective

Describe the effects of human practices on the transfer of matter through natural systems.



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## Key Vocabulary

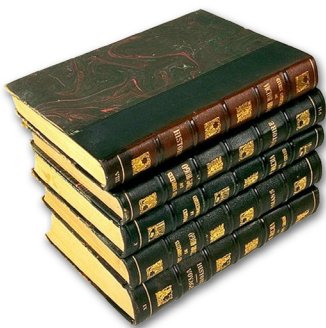
**Extinct:** Death of every member and population of a species.

## Toolbox



### Summary of Activities

Students read *Where Are the Wolverines?—Part 2.* In groups, they review information about changes in the Sierras over the last 200 years, present summaries about causes and effects of environmental change, and discuss the difficulty in ascribing a given change to a single cause.



### Instructional Support

See Unit Resources, page 21

### Prerequisite Knowledge



- Students should understand that humans obtain many products from and engage in many uses of forests. Obtaining those products affects the environment in many ways, including the transfer of matter through natural systems.
- Students should be familiar with the natural history of the wolverine. (See *Where are the Wolverines?—Part 1.*)

### Advanced Preparation

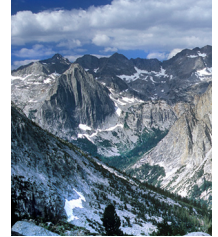


#### Make copies:

Make copies as indicated in the Activity Masters section below.

#### Prepare puzzle pieces:

Copy the puzzle pieces onto cardstock. (optional) Cut apart the puzzle piece cards to create one class set.



## Materials Needed



**Activity masters:**  
See below

## Visual Aids



**No visual aids are required for this unit.**

## Duration



**Preparation time:**  
15 min.  
**Instructional time:**  
45-60 min.

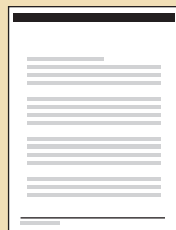


**Safety Notes**  
None

## Activity Masters



**Cause and Effect  
Puzzle Pieces**  
Page 81  
One set per class



**Where are the  
Wolverines? -  
Part 2**  
Page 86  
One per student



**Cause and Effect  
Study Guide**  
Page 87  
One per student



# Procedures

## Step 1

Review the natural history of wolverines as presented in **Where Are the Wolverines? - Part 1** (Lesson 1 Activity Master).

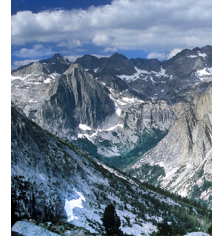
## Step 2

Remind students that scientists have considered the decline of the wolverine to be somewhat of a mystery. They have conducted studies to try to determine what may have caused the wolverine to markedly decline or virtually disappear from the Sierra Nevada Mountains. Point out the meaning of extinction by writing the definition on the board. Challenge the students to help scientists solve this puzzle. Ask, “Although extinctions happen naturally, what kinds of human practices might cause an animal like the wolverine to become extinct in the Sierra Nevada Mountains?” List students’ ideas on the board.

## Step 3

Organize students into groups of two or three. Give each group one of the **Cause and Effect Puzzle Pieces** (Lesson 5 Activity Master). Explain that each puzzle piece describes changes in the Sierra Nevada Mountains during the past 150 years. Ask groups to read the information on their puzzle piece and work together to prepare and present a brief summary to the rest of the class. The summary should:

- describe the change
- answer the question, “Could this change be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?”
- explain students’ rationale for their choice



### Step 4

Have each group present their brief summary of their puzzle piece and explain their reasoning as to whether their particular change might or might not have caused the wolverines to become extinct in the Sierra. Record the results and brief rationales on the board.

### Step 5

Distribute copies of *Where are the Wolverines?—Part 2* (Lesson 5 Activity Master). Read the story and discuss the changes that have occurred in the wolverine's habitat over the past 150 years. (Logging, development for housing, roads, and grazing of sheep and cattle) Combine the existing small groups into groups of four to six students. Ask the new groups to compare the explanation in the story to the class results posted on the board. Discuss reasons for any differences. Bring the class together and briefly share and discuss insights as to what happened to the wolverine in the Sierra Nevada Mountains. Conclude by pointing out that human practices often result in loss of habitat for other species. The habitat loss can interrupt the flow of matter through natural systems. Explain that loss of habitat is the leading cause of extinction, and the primary reason species populations become threatened or endangered. Human practices that are not well thought through sometimes have unintended consequences and affect wildlife and habitats more than anticipated. Ask for ideas on how the decline in wolverine population might have been avoided.

## Lesson Assessment

# Instructions

### Description:

The EEI Learning Objective for Lesson 5 requires students to describe the effects of human practices on the transfer of matter through natural systems. Students will use *Where Are the Wolverines?—Part 2* (Lesson 5 Activity Master) to answer the **Cause and Effect Study Guide** (Lesson 5 Activity Master) and demonstrate their understanding of the influences of human practices on the flow of energy through natural systems.

### Instructions:

Distribute the **Cause and Effect Study Guide** in class or for homework. Check that all students have a copy of *Where are the Wolverines?—Part 2*. Instruct students to use the information in the reading to answer the questions on the **Cause and Effect Study Guide**. Collect student work.

### Suggested Scoring

#### Scoring Method:

Samples answers for the **Cause and Effect Study Guide** are provided on page 59.





## Cause and Effect Study Guide Sample Answers (Lesson 3 Activity Master)

1. Describe how each of the following activities might have contributed to the decline of the population of the wolverines and how each might benefit people?

Example:

Activity	Possible Contribution to the Decline of Wolverine	Potential Benefits to People
<b>Deer hunting</b>	<i>Deer hunting reduced an important winter food source for the wolverines.</i>	<i>Deer hunting provided a recreation and food for families.</i>
<b>Highways connecting California and Nevada</b>	<i>Many more people traveled between the states. The roads cut through wolverine habitat and affected where they could live.</i>	<i>It was easier for people to travel between the states for travel for work and recreation.</i>
<b>Logging</b>	<i>Logging reduced the areas where wolverines could live.</i>	<i>There were more jobs and it provided building materials.</i>
<b>Mining for gold</b>	<i>Large amounts of soil washed into mountain streams.</i>	<i>Gold mining brought miners and early settlers to the area. New towns were built and new industries were started.</i>
<b>Wearing wool clothing</b>	<i>Wolverines lived in higher grasslands where ranchers grazed sheep. They poisoned wolverines to protect their livestock.</i>	<i>Wool from sheep was used in California and other states to make warm clothing.</i>

2. Human activities like logging and building roads influence natural systems. Provide two examples of how logging and building roads influence natural systems. Provide two examples of how people benefit from logging and building roads. (1 point per answer)

*Logging and building roads can cause habitat loss and the construction of road can block the paths animals cross as they move throughout their range. Logging provides lumber for people to construct buildings and building roads makes it easier for people to travel to different areas.*

3. Logging in the Sierra increased at the same time the wolverine population decreased. Does this prove that the logging caused the decline of the wolverine; that is, was this a cause-and-effect relationship? Why or why not? (2 points)

*No. No one thing caused the wolverines to disappear from California's mountains. A combination of factors caused their decline.*

4. Describe two effects of human practices that change how energy moves through natural systems. (2 points)

*Building new housing can take away grasses. If rabbits do not have enough food and move away, there will not be enough food for animals like foxes that eat rabbits. This has an effect on how energy moves through natural systems.*

*If new roads are not carefully built, chemicals can wash into the water killing organisms like insects. When insects die it affects their flow of energy to other consumers.*

*Flowering plants are producers. When they are removed from an area, a food supply is removed for insects like bees. If bees do not have flowers to visit and eat and pollinate, there will be fewer plants as a food supply.*



## Lesson 6

© Kip Evans Photography

# Making Choices: The Effects of Human Consumption

**T**his lesson provides students with the opportunity to apply the ecological principles they have learned about in this unit to realistic land use issues. Students review brief scenarios that propose specific changes in land use patterns. In each scenario, making the proposed change has advantages and disadvantages.

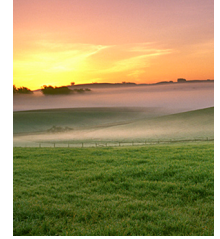
Students evaluate information on both sides of the issue and write a persuasive essay either supporting or opposing the proposed change.

In giving equal weight to both arguments, students must consider multiple viewpoints. Doing so helps

to develop an understanding of the variety of factors that influence decision making about land use patterns. In developing their persuasive essays, students draw on their knowledge of populations and energy transfer. They also consider the potential byproducts

of the proposed changes. In the end, they see that the type of change, the extent of change, and the byproducts resulting from change all contribute to the total effect of human use of natural systems.





## Background

Environmental issues are usually quite complex with many variables—economics, ecology, personal values—coming into play. To make informed choices about environmental issues, people must understand and weigh all perspectives. Even when people feel strongly about one side of an issue, understanding multiple perspectives helps them argue effectively for their position.

Not everyone has the same attitude towards the environment. Where some might see a stand of trees and want to preserve it as a park, others may prefer to harvest the lumber. Still others might see an opportunity to develop a new road or shopping center. Each potential use influences the ecosystem in a different way, and each has advantages and disadvantages. People making land use decisions need to consider immediate gains and

## Learning Objective

Provide examples of how the quantities of resources consumed, and quantity and characteristics of the resulting byproducts can affect natural systems.



long-term consequences for people and for the organisms living in the ecosystem in question.

Governments now require prepa-

ration of an environmental impact report for most major developments. Such reports inform choices and help make sure that decision-makers consider and in some cases, prevent future consequences before development occurs. Still, land use choices affect the natural systems upon which people and all other living things depend.

Early in the country's history, land seemed unbounded and resources plentiful. As the human population increased, so did pressures to develop additional land. Land use regulations came about as people became aware that unrestricted use of land caused resource problems to develop. Water became polluted; habitat became spoiled; species became endangered, often as the unintended result of actions taken without adequate knowledge or consideration of their future effects.



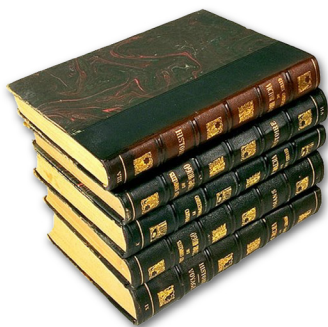


# Toolbox



## Summary of Activities

Students review realistic scenarios that propose changes in land use patterns. Working in pairs, students discuss both sides of their issue to develop an understanding of how use of resources affects natural systems. Then each student will write a persuasive essay, either supporting or opposing the proposed action.



## Instructional Support

See Unit Resources, page 21

### Prerequisite Knowledge



- Students should understand ways in which organisms depend upon their habitat for survival. They must be able to discuss ways that human changes in the environment can affect organisms.
- Students should also understand that a persuasive essay is a form of a composition that: **a.** requires a clear position on a proposition, **b.** supports the position with organized and relevant evidence, and **c.** anticipates and addresses reader concerns and counterarguments.

### Advanced Preparation

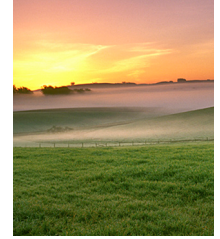


#### Make copies:

Make copies as indicated in the Activity Masters section below.

#### Select editorial:

Review local newspapers (or grade-level Reading-Language Arts instructional materials) and select an editorial that can serve as an example of a persuasive essay. Ideally, the editorial should address a local land use issue in the students' area



## Materials Needed



**Activity masters:**  
See below

## Visual Aids



None provided, however teachers may want to make transparencies of the same editorials

## Duration



**Preparation time:**

15 min.

**Instructional time:**

90 min.

(Two, 45-minute sessions)



## Safety Notes

None

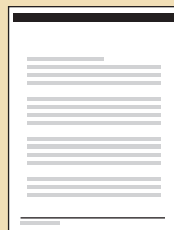
## Activity Masters



**Persuasive Essay  
Self-Evaluation  
Guide**

Page 88

One per student



**Land Use  
Scenarios**

Page 89

One set per class



**Persuasive Essay  
Peer & Teacher  
Evaluation**

Page 97

One per class or  
one per student  
(optional)

# Procedures

## Step 1

Have students read and discuss an editorial on a local land use issue. Discuss that an editorial is a type of persuasive essay. Ask students to summarize the issue discussed in the editorial. Discuss the advantages and disadvantages of the alternatives proposed in the editorial. Consider potential consequences for people and for other organisms affected by the proposed change in land use. Explain the need to consider consequences before making decisions about land use.

## Step 2

Discuss with students the purpose of a persuasive essay such as an editorial. Note that the best persuasive essays:

- state a clear position on a proposition
- support the position with organized and relevant evidence
- anticipate and address reader concerns and counterarguments

Point out that controversies arise because people have different opinions and values. All perspectives on an issue have merit. Considering all viewpoints allows individuals to be confident about their own choices. It also helps them develop convincing arguments to support their views.

## Step 3

Distribute the **Persuasive Essay Self-Evaluation Guide** (Lesson 6 Activity Master) to each student. Explain that working in pairs, students will examine and discuss a land use scenario. Each student will write a persuasive essay that either supports the proposed action or opposes the proposed action. This worksheet is a checklist to guide their work and ensure they include all required parts. They will also use it to assess the quality of their work. They will submit this form to the teacher along with their assignment.

Review the elements listed on the rubric with the students.





### Step 4

Pair students and distribute the **Land Use Scenarios** (Lesson 6 Activity Master). Give one scenario to each pair of students. Ask them to review their scenario and think through arguments that support and oppose the proposed land-use plans. Explain that although the scenarios are fictitious they represent realistic situations. *(Note: Students may need assistance interpreting the details of their scenarios.)*

Tell the students that the next day in class each of them will write a persuasive essay representing one of the perspectives. *(Note: Students may choose to write from a perspective that that does not match their personal opinion.)*

### Step 5

Next day in class: instruct students to write their persuasive essays *(Note: the writing style should match the 6th-grade standards for writing persuasive compositions 6.2.5.)* Specifically instruct the students to include examples of how the quantities of resources consumed, and quantity and characteristics of the resulting byproducts can affect natural systems discussed in their scenario.

### Step 6

Have a few volunteers read their persuasive essays aloud. *(Note: allow students to take their work home if they want to revise their persuasive essays.)*

Discuss some of the examples of how the quantities of resources consumed, and quantity and characteristics of the resulting byproducts can affect natural systems discussed in their scenario.

## Lesson Assessment

# Instructions

### Description:

The EEI Learning Objective for Lesson 6 requires students to provide examples of how the quantities of resources consumed, and quantity and characteristics of the resulting byproducts can affect natural systems. Students will write a persuasive essay that either supports or opposes a proposed land use action.

### Instructions:

#### For teachers:

See Steps 3, 4 and 5 in the lesson's Procedures. If appropriate, students can use the **Persuasive Essay Peer & Teacher Evaluation** (Lesson 6 Activity Master) to peer-assess their work before handing it in to the teacher for scoring.

### Suggested Scoring

#### Scoring Method:

Rubric for Assessing the Essay on Land Use

Scale:

- 4 Excellent
- 3 Very Good
- 2 Sometimes good
- 1 Needs Improvement

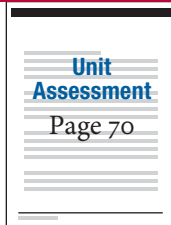
## Unit Activity Masters and Visual Aids



# Unit Activity Masters

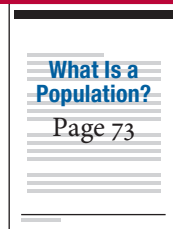
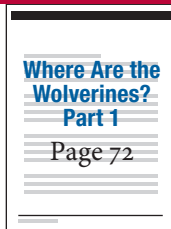
## Unit Assessment

Energy -  
Pass It On!



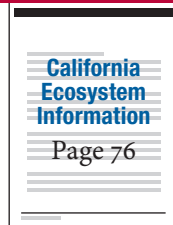
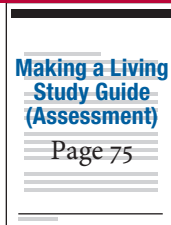
## Lesson 1

What is a  
Population?



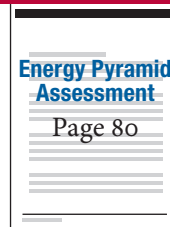
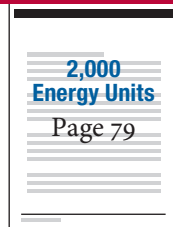
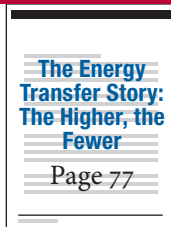
## Lesson 2

Making a  
Living



## Lesson 3

The Higher,  
the Fewer



**Lesson 4**

## It is All Connected

No Activity Masters are used in the lesson.

**Lesson 5**

## Cause and Effect?

Cause and Effect Puzzle Pieces

Page 81

Where Are the Wolverines? - Part 2

Page 86

Cause and Effect Study Guide

Page 87

**Lesson 6**

## Making Choices: The Effects of Human Consumption

Persuasive Essay Self-Evaluation Guide

Page 88

Land Use Scenarios

Page 89

Persuasive Essay Peer & Teacher Evaluation Guide

Page 97

**Unit Assessment** (Activity Master) *page 1 of 2*

Name: \_\_\_\_\_

For each multiple choice question, select the letter of the choice that best completes the sentence. Mark your choice in the space at the left. Be sure that your answers are easy to read!

- \_\_\_\_ 1. An organism that uses the energy of the sun to make its food is called a (an)  
a. herbivore      b. consumer      c. carnivore      d. producer
- \_\_\_\_ 2. Organisms that obtain their energy from foods that they eat are called  
a. plants   b. consumers   c. producers      d. trophic levels
- \_\_\_\_ 3. An animal, such as a deer, that primarily eats plant material is called a (an)  
a. omnivore      b. producer      c. herbivore      d. carnivore
- \_\_\_\_ 4. An animal, such as a lizard, that primarily eats other animals is called a (an)  
a. omnivore      b. producer      c. herbivore      d. carnivore
- \_\_\_\_ 5. An animal that eats both plants and animals is called a (an)  
a. omnivore      b. producer      c. herbivore      d. carnivore
- \_\_\_\_ 6. Organisms, such as bacteria, that obtain their energy by breaking down dead organisms are called  
a. producers                      b. herbivores                      c. carnivores                      d. decomposers
- \_\_\_\_ 7. Animals, such as vultures, that eat dead organisms are called:  
a. decomposers                      b. scavengers                      c. producers                      d. herbivores
- \_\_\_\_ 8. Which of the following would be considered a scientific description of a population?  
a. 147 catfish lived in the pond last summer  
b. There were now 34 deer.  
c. 35 students  
d. There are now fewer bears living in the forest.
- \_\_\_\_ 9. At each trophic level, less energy is available to the organisms than was available to the organisms at the lower trophic level. This is because:  
a. Most organisms are wasteful.  
b. Organisms use energy in the process of living.  
c. Most organisms try to conserve energy.  
d. Organisms store energy rather than pass it on.
- \_\_\_\_ 10. A commonly used estimate of the amount of energy available to the next trophic level in a food chain is about \_\_\_\_%.  
a. 1%                      b. 10%                      c. 50%                      d. 75%                      e. 90%
- \_\_\_\_ 11. In a food pyramid, which of the following would be considered a primary consumer?  
a. bobcat                      b. bacteria                      c. vulture                      d. rabbit
- \_\_\_\_ 12. In a food pyramid, which of the following would be considered a secondary consumer?  
a. mouse                      b. deer      c. worm                      d. hawk
- \_\_\_\_ 13. In a food pyramid, humans are  
a. producers                      b. consumers                      c. scavengers                      d. decomposers



**Unit Assessment** (Activity Master) *page 2 of 2***Essay Questions:**

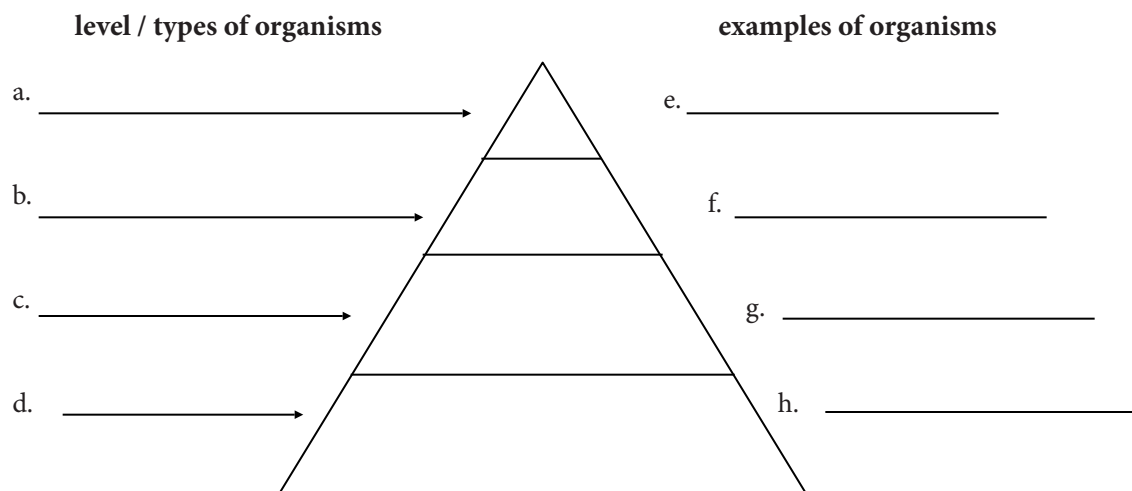
14. Tell how energy from the sun enables a top carnivore such as a mountain lion to live. Show your understanding of the following terms as you use them in your essay:

**producer    photosynthesis    consumer    herbivore    carnivore**

15. Label the trophic levels of the energy pyramid below. Use the following terms in your labels in the left column: (Some of lines a-d will have more than one term.)

**first-level consumer    producer  
second-level consumer    herbivore  
third-level consumer    carnivore**

In the right column, give an example of an organism that is at that trophic level.



16. If 100,000 units of energy are stored in the grass in the following food chain, how many units of energy would the hawk have?

17. Explain why the hawk has less energy than is found in the grass.

**grass → grasshopper → frogs → snakes → hawks**

18. A city needs to widen the road going through a forest to a nearby lake. Name two parts of the road widening process that could affect the lake and forest ecosystem.

19. Could the widening of the road affect the food/energy pyramid in the lake or in the forest? Explain why or why not.

## Where Are the Wolverines?—Part 1 (Lesson 1 Activity Master)

Wolverines once roamed the Sierra Nevada Mountains. However, nobody has seen one in California since 1953. Today, most scientists believe the mammal either no longer lives in the state, or is very rare. What happened to California's wolverines?

With thick bushy coats, broad heads, and short furry ears, wolverines look like small black bears. Along with their sharp teeth and claws, they use foul-smelling musk oil to defend themselves. The musk oil makes them smell like a skunk. These features earned the wolverine the nickname of "skunk bear."

Wolverines eat many kinds of foods. Their prey includes hoary marmots, mice, gophers, deer, and pikas. Pikas are small rabbit-like animals that live at high elevations. Wolverines are both carnivores and scavengers. Carnivores kill and eat meat. Scavengers feed on dead animals, also called carrion. Carrion is an especially important part of the wolverine's diet in winter.

Wolverines are about the size of a small collie. They are the largest member of the weasel family. They are also the most ferocious. Wolverines are remarkably strong for their size. They have been known to kill animals as large as a moose. Their powerful jaws and sharp claws make them powerful predators. Their teeth are sharp and strong enough to chew through bone and carrion that has frozen in the snow.

What wolverines lack in size, they make up for with aggressiveness. A large wolverine might weigh only 40 pounds. But it will challenge much larger predators and steal their prey. Hunters and trappers have witnessed 1,000-pound grizzly bears leaving their meals behind when a wolverine approaches.

Wolverines normally live high in the mountains. They usually are found in high open areas where it is too cold and snowy for trees to grow. Wolverines share their habitat with populations of other small- and medium-size mammals, birds, insects, and fungi that they hunt and eat. Other, larger predators like mountain lions, bears, and wolves also live in the same region. These predators compete with wolverines for food.

Wolverines are well adapted to live and hunt in the snow. Their fur is thick and keeps them warm. Their feet are large so they can walk easily on snow. If they are

hungry, they can even use their long claws to dig ten feet into the snow to find hibernating animals.

Snow plays a very important role in wolverine survival. Female wolverines raise their babies in dens built in deep snow layers. These dens are long, complex snow tunnels that protect the young from predators and provide warmth in the cold climate. If there is not enough snow, wolverine babies may not survive to adulthood.

Two things help determine the size of the territory each wolverine needs. One is having adequate sources of food. The other is being able to find a suitable place for a den. Wolverines cover many miles in a day of hunting. Each animal needs lots of space to hunt and raise its young. Wolverines fight off other wolverines that try to enter their home territory. This limits the total number of wolverines that might live in a region. It is one of the reasons that wolverines are considered one of the rarest mammals in North America.

While wolverine numbers were never very high, there were enough around in the 1800s that trappers considered them pests. Trappers would lose money when hungry wolverines stole animals from their traps. The trappers used poisoned bait to kill wolverines.

Early settlers reported wolverines stealing food from their cabins. The "skunk bears" sometimes ruined settlers' belongings with their musk and urine marking. Wolverines were considered particularly fierce and dangerous animals. They were often killed when the opportunity arose.

Because wolverines are very secretive and travel across huge ranges, they are hard for scientists to study. Many things about the species are not known. But one thing is sure. Wolverines used to live throughout the higher reaches of the Sierra Nevada Mountains. Now they are exceedingly rare. Their decline is a mystery scientists want to explore.



Name: \_\_\_\_\_

**What Is a Population?** (Lesson 1 Activity Master)

You have probably heard the word “population.” Even though population is a common word, it has several different meanings, or definitions. In science, it has a specific meaning. By doing this activity, you should:

- learn at least two different meanings of the term population
- learn the scientific meaning of the term population

Use a dictionary to find two meanings of the term “population.” Write those meanings below and write sentences that show at least two of those meanings.

The dictionary that I used was:

Title (or URL for an Internet dictionary)

Publisher: city \_\_\_\_\_ state \_\_\_\_\_ company \_\_\_\_\_ date (year) \_\_\_\_\_

Meanings

A. \_\_\_\_\_

B. \_\_\_\_\_

Sentence Showing That Meaning

A. \_\_\_\_\_

B. \_\_\_\_\_

2. Now that you know some dictionary definitions of population, find out how some other people would define it. Ask at least two other students and one adult to define population and use it in a sentence.

Student #1

Meaning \_\_\_\_\_

Sentence \_\_\_\_\_

Student #1

Meaning \_\_\_\_\_

Sentence \_\_\_\_\_

Adult

Meaning \_\_\_\_\_

Sentence \_\_\_\_\_



**What Is a Population?** (Lesson 1 Activity Master) *continued*

3. Look up the word population in your textbook. Write the definition here:

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4. List the three parts of the scientific definition of the word population:

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

Write a sentence that demonstrates your understanding of the scientific meaning of the word “population.”

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Name: \_\_\_\_\_

**Making a Living Study Guide** (Lesson 2 Activity Master)

For this assignment, you will complete a Study Guide that includes information on the organisms and different functions they serve in a particular ecosystem. Your teacher will assign the ecosystem.

You will first need to do some research on the ecosystem that you select to find out what organisms live there and what their roles or functions are. In the space provided, identify the sources of your information.

Identify at least two typical examples of organisms that live in the identified ecosystem representing: producers, consumers (herbivores, carnivores, scavengers and omnivores) and decomposers on the table provided.

My ecosystem type is: \_\_\_\_\_ (1 point)

Role or Function		Examples of Typical Organisms
<b>Producers</b>		(2 points)
<b>Consumers</b>	Herbivores	(2 points)
	Carnivores	(2 points)
	Scavengers	(2 points)
	Omnivores	(2 points)
<b>Decomposers</b>		(2 points)

Source(s) of information: \_\_\_\_\_ (2 points)

Questions:

1. What would happen to the consumers if there were no producers? (5 points)

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2. What would happen if there were no decomposers? (5 points)

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3. Why are people considered to be consumers? (5 points)

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## California Ecosystem Information (Lesson 2 Activity Master)

Ecosystem	Producers	Representative Consumers				Decomposers
		Herbivores	Carnivores	Omnivores	Scavengers	
<b>Rocky coast</b>	algae, including some plankton	some snails, some plankton, some fish	anemones, sea stars, octopus, some fish	crabs, gulls, some fish	crabs, gulls, some fish	bacteria
<b>Marsh</b>	algae, including some plankton, marsh grasses, cattails	some plankton, snails, ducks, some fish	some snails, egrets, herons, some fish	crabs, gulls, some fish	crabs, gulls, some fish	bacteria, worms
<b>Pond or Lake</b>	algae, aquatic grasses	some plankton, snails, some fish, ducks	some fish, turtles, insects	some fish	crawdads, some insects, some fish	bacteria, worms, fungi
<b>Grassland</b>	grasses, flowers	insects, birds, mice rabbits, gopher, prairie dogs, antelope	insects, birds, gopher snake, lizards, fox, hawk	coyotes, badgers	coyotes, turkey vultures, insects	bacteria, fungi, worms
<b>Desert</b>	cacti, creosote bush, ocotillo	insects, birds, mice, rabbits, kangaroo rats, tortoises	rattlesnake, lizards, roadrunners	coyotes	coyotes, turkey vultures, insects	bacteria, fungi
<b>Chaparral</b>	coyote bush, sage brush, poison oak, grasses	insects, birds, mice, rabbits, deer, quail	rattlesnakes, lizards, foxes, bobcats, mountain lions	coyotes, opossums, skunks	coyote, turkey vultures, insects	bacteria, fungi, worms
<b>Oak woodland</b>	oak trees, grasses, wildflowers	insects, birds, mice, rabbits, deer, squirrels	snakes, lizards, foxes	coyotes, opossums, skunks, bears	coyote, turkey vultures, insects	bacteria, fungi, worms
<b>Coast redwood forest</b>	redwood trees, Douglas-fir trees, poison oak, ferns tanoak, moss	insects, deer, birds, voles, squirrels	foxes, owls, salamanders, newts	opossums, skunks, bears, raccoons	insects, crows	bacteria, fungi, worms
<b>Pine forest</b>	various types of pine trees, Manzanita, shrubs, grasses	insects, deer, birds, squirrels, chipmunks	foxes, owls, bobcats, snakes, lizards	opossums, skunks, bears, raccoons	insects, crows, turkey vultures, coyotes	bacteria, fungi, worms



## The Energy Transfer Story: The Higher, the Fewer (Lesson 3 Activity Master)

### **Narrator (pointing to the “sun”):**

Every day, lots of energy comes to the Earth from the sun. That energy can be used for many things such as heating houses and water and generating electricity. However, people and other animals cannot use the sun’s energy for life processes such as breathing and growth. Only plants can do that.

### **Sun (pointing to 10,000 energy units represented by squares on graph paper):**

I am the sun. I shine on Earth all day long, sending huge amounts of light energy to the planet’s surface. Most of that energy is reflected back into the atmosphere, but pavement and oceans and plants and other things on which my rays fall absorb some of it. But plants are the only things that can use my energy to produce the chemical energy they need to live. The squares on this graph paper represent 10,000 units of light energy from the sun.

### **Plant (pointing to 100 energy units):**

I am a grass plant, a producer, and I am able to absorb and store about 1% of the energy that reaches me from the sun. The rest of the energy from the sun is reflected away. Through photosynthesis, I turn light energy into sugars and starches, which I store in my stem and leaves. This stored energy is my source of food; I use it to live and grow. I am called a producer because I make food out of the sun’s energy. Plants are the start of most every food chain on Earth. We are called the first trophic level. These squares represent 100 units of energy, which is only 1% of the light energy that reached me from the sun.

### **Narrator:**

Plants store the chemical energy in sugars and starches for their own use. Sometimes, though, a plant is eaten by an herbivore such as a rabbit and that food energy is transferred.

### **Rabbit (pointing to 10 squares):**

I am rabbit. I eat plants, so I am an herbivore. Sometimes I am called the first consumer or first level consumer. Herbivores form the second trophic level, or the second step in a food chain. I use most of the energy that I consume just to stay alive—to move, hunt for food, escape enemies, find shelter, build my body, and other life processes. Only about 10% of the energy that I take in is available to whatever might eat me.

### **Narrator:**

And there are many things that like to eat rabbits! As you know, meat eaters are called carnivores.

### **Coyote (pointing to 1 square):**

I am a coyote, and I am a carnivore. Since I eat first level consumers such as rabbits, I am sometimes called the secondary consumer or the second level consumer. Like all consumers, I use most of my energy just to live. I need energy to hunt for and catch my food, or dig a burrow for my den. Why, I use energy just to breathe, digest my food, and to keep my heart beating! Only about 10% of the energy that I take in is available to whatever might eat me.

**The Energy Transfer Story: The Higher, the Fewer** (Lesson 3 Activity Master) *continued***Narrator:**

Depending on the food chain, another carnivore, such as a mountain lion or wolverine, might eat the first level carnivore. Another example of this is one fish eating a smaller fish, or a snake eating a frog. Sometimes the first carnivore dies and is eaten by a scavenger, or its body is used by decomposers such as fungi and bacteria.

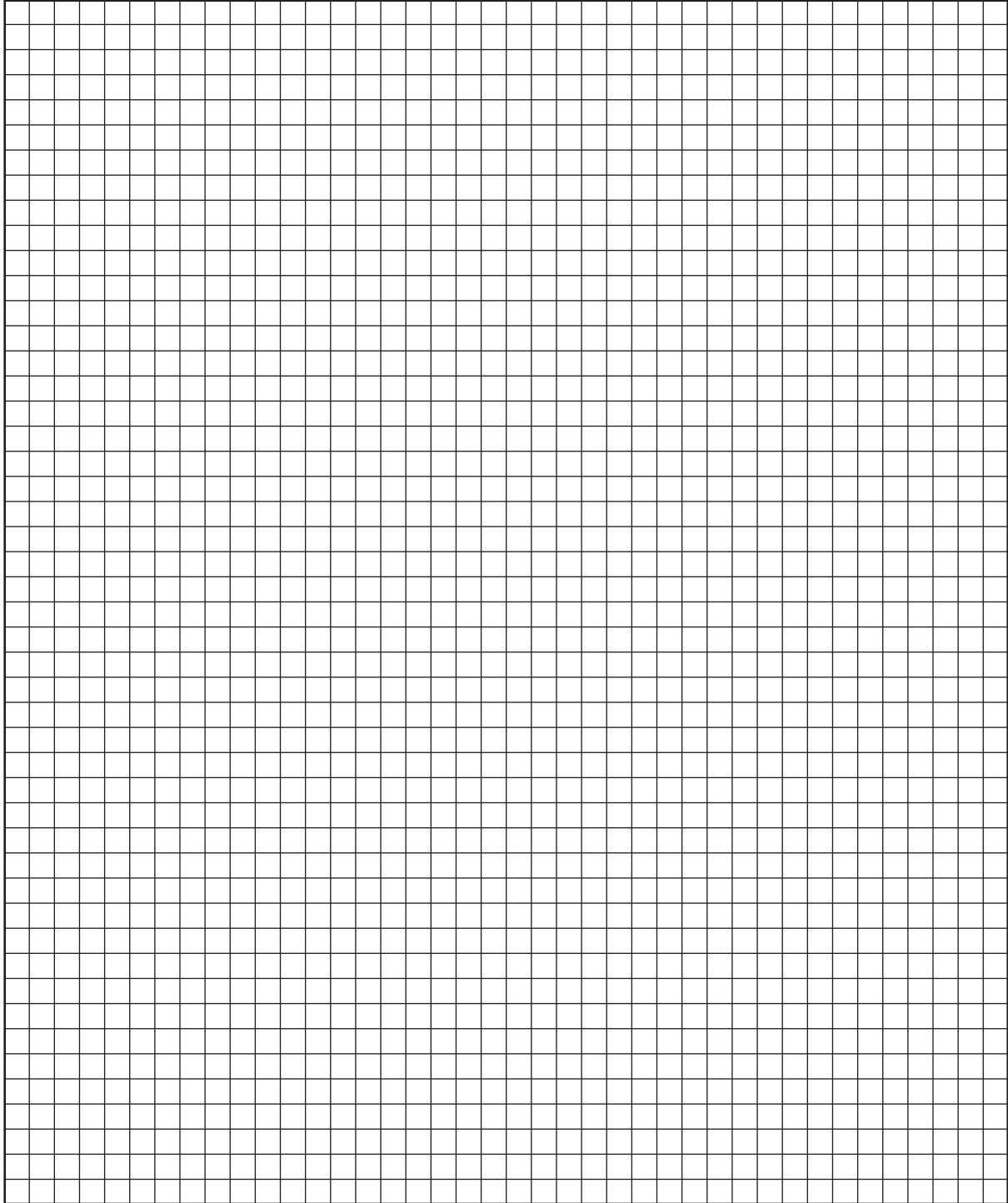
**Mountain lion (pointing to the mountain lion unit of energy 0.1 square):**

I am a mountain lion, and I will eat almost anything! I will even eat a coyote if I find one! Like all of the other organisms in this food chain, I use most of the energy that I take in just to stay alive! Whether I am a mountain lion eating a coyote, an eagle eating a fox, a crab eating a dead fish, or a million bacteria decomposing a dead bear, I can only capture about 10% of the energy in my food!

**Narrator:**

So we see that only a tiny fraction of the energy that comes from the sun is stored in plants. Plants use that energy for photosynthesis to produce sugars and starches. In addition, when consumers feed on plants or other consumers, they only capture about one tenth of the energy in their food. And that is why it takes so many plants to support one wolverine, eagle, salmon, or human being!

**2,000 Energy Units** (Lesson 3 Activity Master)



- Mountain lion unit of energy



Name: \_\_\_\_\_

**Energy Pyramid Assessment** (Lesson 3 Activity Master)

Use the Word Bank below to complete the sentences in Questions 1-7: (14 points)

**Word Bank**

---

consumer	producer	tertiary consumer
energy pyramid	secondary consumer	trophic level
primary consumer		

---

1. An organism that obtains energy and materials by eating other organisms: \_\_\_\_\_
2. Third consumer in a food chain; an organism that feeds on a secondary consumer: \_\_\_\_\_
3. An organism such as a plant or alga that uses light energy or chemical energy to produce food (sugar) from inorganic chemicals: \_\_\_\_\_
4. The second consumer in a food chain; an organism that feeds on a primary consumer or herbivore: \_\_\_\_\_
5. A step in a food chain or food web; producers are the first level, herbivores the second, carnivores that feed on herbivores are the third, and so forth: \_\_\_\_\_
6. In a food chain, the first consumer; an herbivore: \_\_\_\_\_
7. A model that shows that about 90% of the energy in organisms at a given trophic level is lost as the organisms are consumed by organisms at the next trophic level: \_\_\_\_\_
8. Draw the energy pyramid including: grass, rabbit, coyote, and mountain lion. Label each by their function: producers, primary, secondary, and tertiary consumers. And, label the three trophic levels; (6 points)

## Cause and Effect Puzzle Pieces (Lesson 5 Activity Master)

### Puzzle Piece 1: Loss of Prey

**Could loss of prey be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

Wolverines are carnivores. They eat other animals, whether those animals are dead or alive. Deer, mice, gophers, marmots, and picas are among the prey species that wolverines eat. If anything causes the numbers of prey species to go down, wolverines might go hungry. If wolverines cannot get enough to eat, their numbers will go down too. Scientists do not know very much about the numbers of marmots and picas. These animals live at high elevations where it is hard to study their population size. However, it is unlikely that people's actions have affected marmots and picas much. Little has been built in these high areas—just a few roads and ski resorts. There is still a lot of marmot and pica habitat in the region.

Wolverines killed and ate many deer. Early settlers in the Sierra also killed and ate many deer. This could reduce the wolverine's food supply. However, the settlers also cleared forests for lumber, ranching, and farming. This created more of the open habitat that deer prefer. This would help keep the number of deer high. The settlers also killed mountain lions and bears. These animals also ate deer. Reducing their numbers made it easier for wolverines to find deer.

Overall, the number of deer probably did not change much as people settled in the Sierra Mountains.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think loss of prey led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*

### Puzzle Piece 2: Killing as Pests

**Could killing wolverines because they were pests be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

Wolverines look a little like small bears. They are quite fearless and ferocious. Many people were afraid of them. When wolverines came around houses, they sometimes got into fights with people's pets. People who saw wolverines were sometimes scared enough to shoot them. Some people believed wolverines were a threat. They could also be a pest. Some wolverines even broke into people's cabins to find food.

Most wolverines lived high in the mountains. Few people lived in these areas. Therefore, the number of wolverines killed because they bothered people was probably small. However, the total number of wolverines was never very large. Killing even a few could affect the overall population size.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think killing wolverines because they were pests led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*

### Puzzle Piece 3: Change in Snowfall

**Could a change in the amount of snowfall be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

Wolverines need snow. They live high in the mountains where there is usually plenty of snow. Wolverines have large feet so they can walk easily on snow. They are better able to hunt in the snow than many other carnivores. Therefore, they face less competition for food at these high, snowy elevations.

Female wolverines build tunnels in deep snow banks to create their dens. The long, complex tunnels protect baby wolverines from predators. The thick snow walls also provide warmth in the cold climate. If there is not enough snow, wolverines babies may not survive to adulthood.

Low snowfall might also mean less water for plants. This might create food shortages for herbivores, which, in turn, could make it hard for wolverines to find food.

Did these conditions exist during the past 150 years? Scientists studied weather records to see if there were periods of time when lack of snow might have affected wolverines or their prey species. Snowfall records for the high Sierra are not complete. However, the average snowfall has not changed very much.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think lack of snowfall led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*

### Puzzle Piece 4: Poisoning by Trappers

**Could poisoning by trappers be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

Fur trappers worked throughout the Sierra Nevada Mountains in the 1800s and early 1900s. They laid traps to capture beavers, ermine, foxes, and other animals with rich coats. Trappers made their living selling the furs. People used furs for clothing, blankets, and more.

The trapped animals made for easy prey. Wolverines often raided traps, stealing and eating the trappers' income. Of course, trappers were not happy when this happened. They sometimes put out poisoned bait for the wolverines. Trappers killed relatively high numbers of wolverines in this manner.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think poisoning by trappers led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*



### Puzzle Piece 5: Logging Trees for Lumber

**Could logging be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

In the past 150 years, California's population has grown. As the human population grows, people must build more and more houses and other buildings. This requires a lot of lumber.

During the Gold Rush in the mid 1800s, many thousands of people came to the California. Logging increased rapidly in the Sierra Nevada Mountains. By 1880, loggers had cut over 1.5 million acres of pine forests. Many species of wildlife lost their habitats.

Wolverines lived high up in the mountains. In these regions, there is a lot of snow but not much water. The soil is not very deep, and winter storms are severe. Therefore, the few trees do not grow very large. Loggers preferred to work at lower elevations where the forests are full of large trees.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think logging led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*

### Puzzle Piece 6: Increase in Human Population

**Could the increase in human population be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

Food is scarce in the high elevations where wolverines live. Wolverines must range over many square miles to find enough food. This is especially true when they have young to feed. Wolverines are also very choosy about where they build their dens. Conditions need to be just right. Therefore, wolverines maintain large home territories. They protect their territories and fight off other wolverines that try to move in.

Starting during the Gold Rush in the middle of the 1800s, more people moved into the Sierra Nevada Mountains. The human population nearly doubled between 1860 and 1960. People built homes, ranches, roads, and towns in areas where wolverines lived.

It is hard for people and wolverines to live in the same place. As human communities grew, there was less open land for wolverines. Some wolverines were forced out of their home territories. They tried to move to neighboring areas, but existing wolverines often fought them off. There were fewer and fewer places where wolverines could survive.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think the increase in human population led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*

## Puzzle Piece 7: Killing to Protect Sheep

**Could killing wolverines to protect sheep be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

Sheep ranching was common in the Sierra Nevada Mountains in the 1800s and 1900s. During summers, sheep ranchers moved their flocks to high elevations. At this time of year, the snow had melted. There was plenty of grass for the sheep to eat.

The slow-moving sheep were easy prey for the wolverines, coyotes, and other predators that lived in these higher areas. They were easier to catch than deer. To protect their flocks, sheep ranchers put out poisoned bait for the carnivores that attacked their sheep.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think killing wolverines to protect sheep led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*

## Puzzle Piece 8: Building Roads

**Could building roads be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

As settlers arrived in the Sierra Nevada Mountains, they built more roads. The roads made it easier for people to get to and move around the area. At first, people used the roads on foot, on horseback, or in stagecoaches. Later, people in cars and trucks used the roads. The roads continued to grow in size and number. Eventually, people could drive high into the Sierras and across the mountains from California to Nevada.

As people built more roads, it became easier to settle in and develop the region. Towns, recreational developments, mining areas, and sheep ranches increased in number.

Building roads broke wolverines' large territories into smaller pieces. This made it harder for wolverines to find food and good sites for dens. Because there were more people in the area, wolverines and people had more interaction. This was not always good news for the wolverines. Cars and trucks also brought noise and air pollution to the mountains.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think building roads led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*

## Puzzle Piece 9: Ski Resorts

**Could building ski resorts be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

People generally build ski resorts high in the mountains, which is where wolverines lived. To make ski runs, people must clear trees from wide areas of the mountainside. They also build ski lifts and lodges. During ski season, thousands of people are on the slopes. They travel to the area by car, bringing air pollution to the mountains. Many vehicles move around the mountains to maintain the slopes and related facilities.

Ski resorts break wolverines' large territories into smaller pieces. This makes it hard for the animals to find food and good sites for dens. Ski resorts also bring many people into the wolverines' environment. The people come during winter, which is an especially difficult time of year for most predators. Food is scarce because prey species often move to warmer areas or hibernate deep under the snow.

With more people in the area, wolverines and people are likely to have more interaction. This is not always good news for the wolverines.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think building ski resorts led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*

## Puzzle Piece 10: Mining

**Could mining be the reason for the overall decline of the wolverine population in the Sierra Nevada Mountains?**

The California Gold Rush brought many miners to the Sierra Nevada Mountains. Most miners worked in the lower areas of the Sierra Nevada Mountains. Although it did occur, mining was not very common at the higher elevations where wolverines lived.

Miners used several different methods to find gold. In some cases, they used huge water cannons to wash away hillsides to get at the gold. This method is called hydraulic mining. Hydraulic mining eroded the soil, or washed it into streams and rivers. Sometimes, the build up of soil actually changed the path of the streams. Areas where salmon and other fish laid their eggs were ruined. Hydraulic mining affected many kinds of plants and animals. Another method of mining used poisonous chemicals to remove gold from rocks. These poisons could end up in waterways and soil. Some mining methods used explosives and were very noisy.

Mining operations brought many changes to the habitat. The mines also brought many people. With the people came settlements, roads, and in later years cars, trucks, and heavy equipment. Most of this mining in the Sierra occurred at mid- and lower elevations. All of these changes in the environment made it difficult for plants and animals to survive in the areas where mining was widespread.

*Your group will need to present the information in this piece of the wolverine puzzle to the rest of the class. Use your own words; do not read the card aloud to the class. Do you think mining led to the overall decline in the wolverine population? Decide yes or no, and be prepared to explain your thinking.*



## ***Where Are the Wolverines?—Part 2*** (Lesson 5 Activity Master)

Wolverines no longer live in California. Scientists set out to explore why. Since wolverines need snow for their dens, a drop in snow levels could explain the disappearance. A decline in population of their prey species might also explain the lack of wolverines. So scientists studied weather patterns and prey populations over the past 150 years. The studies showed that climate and prey populations have not changed much. Food shortages and lack of snow did not cause the decline of the wolverine.

What has changed over the past 150 years? For one thing, the ways people use the land have changed a lot. The discovery of gold at Sutter's Mill in 1848 began a major shift in the region. Is this what caused the wolverine to vanish?

After the Gold Rush started, miners and early settlers built many new towns in the Sierra Nevada Mountains. In 1860, about 150,000 people lived in the region. By 1960, that number grew to around 275,000. The population reached 650,000 in 1990 and will soon pass 1,000,000.

The Gold Rush paved the way for many new industries. In lower elevations, forests were cut to provide lumber for mines and houses. By 1880, over 1.5 million acres of pine forests had been cleared. Different kinds of trees grow at higher elevations. The lumber from these trees is not as good for building, so there was not as much logging in the areas where wolverines generally lived.

Gold Rush mining practices caused huge amounts of soil to wash into mountain streams. This changed the ways the rivers flowed. Farmers also used a lot of water. They took it from streams to water, or irrigate, their crops. In fact, they used more land for farming and ranching in 1860 than in any year since. Irrigation projects continued to grow until the 1920s. They have leveled off since then.

Cattle grazing was common at lower elevations. In the higher grasslands where wolverines lived, ranchers grazed sheep. This practice cleared huge areas of native grasses in the late 1800s. Ranchers worried about wolverines that hunted and killed their livestock. Like trappers, they also poisoned wolverines when they became a threat to the ranchers' income.

Parks were created at Yosemite Valley and Calaveras Big Trees in the 1860s. These were the first parks in the Sierra Nevada Mountains. More parks followed. Tourism brought more people to the area. More people meant more contact with wolverines. Some people were afraid of wolverines and sometimes killed them to protect themselves.

The development of mining, grazing, farming, logging, and recreation all affected the habitat of the wolverine. Finding places to build dens and raise young became difficult. The predators no longer had unbroken home ranges in which to hunt. As their habitat changed, the numbers of some prey species, like the pika, also decreased. Hunters killed deer, reducing an important winter food source for the wolverines. It grew harder and harder for the wolverine to survive in the Sierra Nevada Mountains.

The mystery is solved. No one thing caused wolverines to disappear from California's mountains. A combination of factors contributed to their decline.

Name: \_\_\_\_\_

**Cause and Effect Study Guide** (Lesson 5 Activity Master)

1. Describe how each of the following activities might have contributed to the decline of the population of the wolverines and how each might benefit people?

Example:

Activity	Possible Contribution to the Decline of Wolverine	Potential Benefits to People
Deer hunting		
Highways connecting California and Nevada		
Logging		
Mining for gold		
Wearing wool clothing		

2. Human activities like logging and building roads influence natural systems. Provide two examples of how logging and building roads influence natural systems. Provide two examples of how people benefit from logging and building roads. (1 point per answer) (1 point per answer)

3. Logging in the Sierra increased at the same time the wolverine population decreased. Does this prove that the logging caused the decline of the wolverine; that is, was this a cause-and-effect relationship? Why or why not? (2 points)

4. Describe two effects of human practices that change how energy moves through natural systems. (2 points)

Name: \_\_\_\_\_

**Persuasive Essay Self-Evaluation** (Lesson 6 Activity Master)

Does the essay:	Self Evaluation
Have an interesting headline?	Yes ____ No ____
Provide a description of the purposed land use change?	Yes ____ No ____
Identify what resources would be affected and the quantities affected?	Yes ____ No ____
Identify what populations of organisms would be affected and how?	Yes ____ No ____
Describe why those organisms are important to the energy flow in the natural ecosystem?	Yes ____ No ____
Identify the function of the affected organisms in the ecosystem?	Yes ____ No ____
Clearly state a position, either for or against the proposed change?	Yes ____ No ____
Explain why people should agree with your position?	Yes ____ No ____
Include any quotations or realistic details, and did they add to the article?	Yes ____ No ____
<b>Did you check the essay for:</b>	
Grammar, word use, punctuation, spelling?	Yes ____ No ____
Overall apparent effort and neatness?	Yes ____ No ____
<b>Did you check the article for:</b>	
	Yes ____ No ____



## Land Use Scenarios (Lesson 6 Activity Master)

### JOHN MUIR WOLVERINE PRESERVE

#### What Is There Now

This land is in a national forest. It was logged in the 1950s. Now, a large ponderosa pine forest is growing there. There is also oak woodland and chaparral. Wolverines lived in this area before 1920. No wolverines have been seen there since then. However, there are large populations of deer, bears, coyotes, and other animals in the area. The area will soon be ready for more logging. Many people are looking forward to the jobs the logging will provide.

#### The Proposed Change

The federal government wants to turn this land into a wildlife preserve. No logging, hunting, or motorized vehicles would be allowed. The main goal is to bring wolverines back to California. Scientists will trap five male and five female wolverines in Michigan. They will release the wolverines in the preserve. The scientists will study the wolverines and try to help them survive.

#### Some Points in Favor of the Proposed Change

Wolverines used to live in this area of California. It is natural that they live here. Human actions led to the disappearance of wolverines from the area. People have the responsibility to bring them back. This forest offers the right habitat for wolverines. There is a good food supply.

#### Some Points Against the Proposed Change

This is a large area of beautiful forest. People use this land in many different ways. Many families hike there. Mountain bikers enjoy the trails. Hunters use the area too. The trees are an important source of lumber. Logging offers good jobs for people in this area. Wolverines have not lived here for almost 100 years. Locking up this much good forest for 10 animals is a waste of land.

### PINE CITY MOUNTAIN PARK

#### What Is There Now

Mr. and Mrs. Smith own 100 acres of land near Pine City. Pine City is in the Sierra Nevada Mountains. The Smiths bought the land 50 years ago. The land is mostly pine forest. There are large mature trees that could be valuable for lumber. The Old Pine River flows through the property. Many kinds of forest plants and animals live in the area, including deer, bears, foxes, and trout. Some people claim to have seen wolverines in the area many years ago.

#### The Proposed Change

The Smiths need money for their retirement. They want to sell 90 acres of their pine forest. They would like to sell the land to Pine City for a park. However, Pine Mountain Resource Company is offering to pay more for the land than Pine City can afford. Pine Mountain Resource Company wants to cut down the trees and sell the lumber. They will replant it with a new crop of trees to harvest in another 40 or 50 years.

#### Some Points in Favor of the Proposed Change

If Pine City buys the land, everyone in town can use the park. Residents will have a place to go for camping, hiking, rafting, and fishing. Tourists will also come to use the park. Area stores and restaurants will get more business from the tourists.

#### Some Points Against the Proposed Change

Purchasing this land will cost the city a lot of money. In addition, the city will have to pay to develop and maintain the park. The city will have to charge to use the park. People may not be able to afford to visit. Lumber is a valuable resource, and there is great demand for wood. If Pine Mountain Resource Company buys the land, harvesting the lumber will provide jobs and tax money for the city, county, and state.

## BIG LAKE COUNTY PARK

### What Is There Now

People use the Big Lake National Forest in many ways. Half the area has been logged over the past 100 years. There are large Douglas fir and pine trees growing there now. The Family Forest Resource Company is planning to hire loggers to cut down some of these trees soon. The forest is popular with deer hunters, backpackers, off-road vehicle users, and horseback riders. Deer, coyotes, mountain lions, marmots, squirrels, and many other animals live there. There are many miles of rivers, streams, and logging roads.

### The Proposed Change

The government of Big Lake County wants to buy part of the national forest. They want to create a park. Visitors to the park could go backpacking, fishing, and horseback riding. The county will not allow off-road vehicles, hunting, or logging within park borders.

### Some Points in Favor of the Proposed Change

Big Lake County is a beautiful area. Many people are moving into the area. There are many new housing developments. The new residents like having places to hike and camp nearby. However, complaints about noise and soil erosion caused by off-road vehicles have increased. Many of the people living in the area think of the national forest as a park. Very few are hunters. Most do not like the idea of tourists coming in to shoot deer in their park.

### Some Points Against the Proposed Change

Many people have lived and worked in Big Lake County for a long time. They depend on jobs and taxes provided by the logging industry. Many work for the Family Forest Resource Company. Some people will lose their jobs if the park is created. Many long-term residents enjoy off-road driving and hunting in the national forest. There are already other parks in the county. Maintaining another park would cost tax money. These funds would be better spent on other community issues.

## DESERT DUNES WILDERNESS AREA

### What Is There Now

There are sand dunes in Rocky Basin National Forest. The dunes are a popular place for off-road vehicles. Bird watchers, photographers, and campers also visit often. Many desert animals live in the area. These include coyotes, desert tortoises, rattlesnakes, desert foxes, and roadrunners. There were active gold mines in the early 1900s. Now the mines are closed, although the buildings are still there. New technology could make it possible to find more gold. The value of gold is rising, so some people want to start mining again.

### The Proposed Change

Environmental organizations want to protect the dunes. They want to create the Desert Dunes Wilderness Area. No off-road vehicles or mining would be allowed in this area. The rest of the national forest would remain open for use.

### Some Points in Favor of the Proposed Change

Off-road vehicles threaten some of the endangered species that live in the dunes. Three species of concern are the desert tortoise, the fringe-toed lizard, and Parish's daisy. Without protection, these plants and animals might become extinct. Desert soil is fragile. Off-road vehicles and campers' cars and trucks damage the soil. So does mining. This damage looks ugly and harms the desert ecosystem. It ruins the area for backpackers, bird watchers, and photographers. There are not many healthy desert ecosystems left in California. People should protect this one.

### Some Points Against the Proposed Change

Off-road vehicle driving is a very popular hobby that supports the economy. People who enjoy this hobby need places to go. The national forest dunes are some of the best in Southern California for this sport. Everyone should be able to enjoy the forest. Closing the area to vehicles prevents people from visiting. It would be hard for the elderly, families with young children, and disabled people to get to the dunes. Opening the gold mines would bring jobs and tax money to the local economy.

## EAGLE CREEK WATERSHED TIMBER SALE

### What Is There Now

The Eagle Creek watershed is part of the North Coast National Forest. The lower part of the watershed includes land that was logged about 75 years ago. There are now many large trees growing there. These trees are valuable for lumber. In the upper part of the watershed, the forest is an old growth forest. This means there was never logging in that area. The trees are very old and very large. People have not changed this ecosystem much. Deer, bobcats, black bears, and trout are common in Eagle Creek watershed. Some backpackers think there may even be wolverines living in the area.

### The Proposed Change

The California Timber Company wants to cut down trees in the watershed. The company would sell the trees for lumber. It will pay the U.S. Forest Service for the rights to log the land. California Timber Company will cut select trees from the forest. Some will be old growth trees. They will not clear the land completely.

### Some Points in Favor of the Proposed Change

Californians use a lot of lumber every year. They need lumber to build houses, offices, schools, and community centers. The California Timber Company will help meet that need. The company says it can cut the trees without harming the natural environment. They will plant trees to replace the ones they cut. The U.S. Forest Service manages the North Coast National Forest carefully. Even with past logging, the area is home to many kinds of animals. The local towns will benefit from new jobs. Logging can help prevent forest fires. When a company logs, they remove many dead trees and branches from the area. Right now, these branches are a fire hazard.

### Some Points Against the Proposed Change

There is very little old growth forest left in California. Several kinds of plants and animals can only live in old growth forests. Wolverines are one of these animals. The wolverine is one of the rarest mammals in California. If wolverines do live in this forest, it is very important to protect the habitat from logging. People need lumber, but they can cut trees from areas like the lower watershed. Logging has already affected the natural systems there.

## DESERT SKY HOMES

### What Is There Now

For 90 years, the Acme Mining Corporation has owned a lot of desert land in southern California. The company used to work mines there, but the mines closed many years ago. Now the desert land is home to many kinds of plants and animals. Desert tortoises and many desert plants live there.

### The Proposed Change

The Acme Mining Corporation wants to build on the land they own. They plan to build 500 houses and a small shopping center. The company already owns the land. Therefore, they can afford to sell the houses at relatively low prices. The company expects many people who work in cities about 45 minutes away to buy the homes.

### Some Points in Favor of the Proposed Change

There is not enough low-cost housing in California. Many families cannot afford to buy a house. Acme Mining Corporation can provide 500 families with homes. No one uses this land right now. The project will provide many jobs. Building houses there is good for Acme, good for families, and good for the economy.

### Some Points Against the Proposed Change

Five hundred families means about 2,000 people. Two thousand people need a lot of water for cooking, bathing, and watering lawns. However, there is not a lot of water in the desert. It would cost a lot of money to bring enough water to this area. It would also change the habitat entirely. People will have to drive to the city to work. Commuting uses a lot of gasoline and causes air pollution. It would use fewer resources to build low-cost family housing closer to the city.

## ALLIED GRAINS RICE FARM EXPANSION

### What Is There Now

The Silver River runs through the fields of central California. In winter and spring, the river often floods. This turns the fields into wetlands. During these rainy seasons, many ducks and geese feed in these wetlands. Three species—the Silver River buttercup, the blue watercress, and the red-spotted frog—live only here. They are not found anywhere else on Earth. Farmers grow rice on some of the nearby land.

Bob Williams owns the land. It has been in his family for generations. Long ago, they built levees to keep the river from flooding the land. Now, the levees are broken down and the fields flood each year.

### The Proposed Change

Allied Grains Corporation wants to purchase the land from Bob Williams. The large farming company plans to rebuild the levees. The levees will prevent the fields from flooding. They will plant rice, as in some of the neighboring fields.

### Some Points in Favor of the Proposed Change

This land is not being used productively. Planting rice will make the land useful. California has some of the best rice-growing fields in the world. Rice farmers can work with conservationists to harvest their crop in fall and flood their fields for winter waterfowl. This has been very successful in some areas.

### Some Points Against the Proposed Change

Allied Grains' levees will stop the natural flooding of this land. This will affect all the wildlife in the area. It will be very hard on the ducks and geese that depend on the wetlands in winter. The rare plants and frogs may not survive; they might become extinct. Rice farming requires a lot of water. The farming company has to keep the rice fields wet all year round. To do this, the company must take water from the river. This affects the entire river ecosystem, especially during the summer dry season. Any pesticides or fertilizers used by Allied Grains easily could end up in the river and cause chemical pollution of the land and water.

## SEASIDE ESTATES HOUSING DEVELOPMENT

### What Is There Now

The Barletta Ranch is on three miles of coastal land in central California. The ranch owners raise cattle and sheep. The ranch also provides habitat for wild plants and animals. These include coyotes, gophers, gopher snakes, turkey vultures, and several kinds of rare plants.

### The Proposed Change

The Barletta family wants to divide their land. In one area, they want to build a few expensive houses with a view of the ocean. Lots of open land will surround each house. They plan to sell these houses to wealthy people as retirement or vacation homes.

### Some Points in Favor of the Proposed Change

The Barletta family owns this land. They should be able to do whatever they want with it. It is only fair for them to make money from selling houses on their own land. There will not be many homes, so only limited number of people will move to the area. The impact will be low. The Barletta have ranched this land for a long time. It is not natural habitat.

### Some Points Against the Proposed Change

This ranch provides a place for many plants and animals to live. Although people have changed the land, it is important habitat. California's plants and animals need more land, not less. Now, everyone who drives along this coastline enjoys seeing the ocean. Building big houses will ruin the view for most people. If the Barlettas have to build houses, it would be better for the community to build smaller, lower-cost homes than would serve more people.



## BONANZA COMPUTER CORPORATION PLANT

### What Is There Now

The Arrango family owns ranchland in northern California. They raise cattle and sheep. The ranch is mostly grassland, which is good for grazing. Some oak and pine trees grow there, and the area supports wild foxes, coyotes, rabbits, snakes, and lizards. Many kinds of insects live there too.

### The Proposed Change

The Bonanza Computer Corporation is offering to buy a piece of the Arrangos' land. They plan to build a computer manufacturing plant. They will hire workers from the area to help build the plant. Later they will provide jobs building computers.

### Some Points in Favor of the Proposed Change

The computer plant will provide jobs for 375 people from nearby towns. Unemployment is a big problem in this region; the new jobs will help many families. The Bonanza Computer Corporation will pay county taxes. This income will help the county government do more for the community.

### Some Points Against the Proposed Change

Paving and building on the ranch land would destroy the plants currently living there. Lack of plants affects the animals in the area. They will have to move away to find food. Some animals might die. It takes a lot of water to build computers. The plant will affect water resources in the area. Pollutants from the plant are also a problem. Some of the waste products created in building computers are poisonous. The poisons could get into the soil and water. Having 375 people working in the same place will create more traffic than the small country roads in the area can handle.

## ROBERTS MINING COMPANY EXPANSION

### What Is There Now

The Roberts Mining Company owns land in the southern California desert. They mine several types of ore. Their property is next to federal land. Campers, horseback riders, and off-road vehicle drivers enjoy using these public lands. Coyotes, bobcats, and foxes live in the area. So do desert tortoises, skunks, and rattlesnakes. The rare desert orchid is one of many kinds of desert plants that live there too.

### The Proposed Change

The Roberts Mining Company wants to purchase mining rights on the federal land. They believe there are valuable minerals under the land. When they begin mining, they would fence off the area. It would not be safe for people to use the land for recreation.

### Some Points in Favor of the Proposed Change

People use minerals every day. Many products depend on minerals. If people are going to have cars, computers, and DVD players, mining is necessary. The Roberts Mining Company has run the mines next to this land for a long time. They rarely have accidents. They do their best to limit environmental impact. The mines do not last forever. In about 50 years, the government can reopen the land for public use. Considering how important minerals are to society, this is a small price to pay.

### Some Points Against the Proposed Change

The federal government owns this land. It is public property. The public should be able to use it. The Roberts Mining Company will keep people off the land. They will be making money on land they do not own. In addition, mining will disrupt the land. The plants and animals living there probably will not survive the mining operation. People should conserve more rather than mine more.

## SWIFT RIVER GRAVEL COMPANY EXPANSION

### What Is There Now

The Swift River Gravel Company owns land near the Swift River. They have mined gravel there for over 40 years. Now, they are running out of gravel. The company owns another site closer to the river. That land is forested. It provides habitat for many animals, including raccoons, bears, bats, and birds. The trees shade the river, which makes it cool enough for trout and salmon.

### The Proposed Change

The Swift River Gravel Company wants to start mining on their new site. They plan to clear the trees and begin digging a gravel pit so they can continue to stay in business.

### Some Points in Favor of the Proposed Change

Builders use concrete for buildings, roads, and many other projects. It is a necessary part of modern society. Gravel must be mined somewhere. Swift River Gravel Company has owned this land for a long time. They have always planned to mine gravel at this site. It is not fair to the company to stop them after they paid for the land. Current laws limit the amount and type of gravel mining. Swift River Gravel Company is within the laws controlling their new site. If Swift River goes out of business, 75 people will lose their jobs.

### Some Points Against the Proposed Change

Mining laws do not go far enough. Even when companies follow the laws, mining creates noise and pollution. People living near the existing gravel pit are tired of the noise and danger caused by gravel trucks. They want to see the mine closed. They are worried about the effects of the new gravel mine on the river. Mining produces small soil particles that will end up in the water. Cutting the trees along the river will affect the temperature and quality of the water. This will affect the fish and other plants and animals that live in the river.

## BIG MOUNTAIN SKI RESORT

### What Is There Now

Big Mountain is in the Central Sierra National Forest. Pine trees cover the mountain. Every summer, hundreds of people hike and ride horses on Big Mountain. Many also camp at Trout Lake on the eastern side of the mountain. Trout and two kinds of frogs live in the lake. The area is also home to mountain lions, bears, coyotes, squirrels, chipmunks, and birds. Some people think there may be wolverines in the area. Nobody is certain about seeing one for many years.

### The Proposed Change

The North American Ski Corporation wants to build a large ski area on Big Mountain. The project includes ski runs on both the western and eastern sides of the mountain. The company will build a ski lodge at Trout Lake. They will also add a lodge and parking lot at the base of the mountain. During winter, skiers will fill the mountain. In summer, tourists and mountain bikers will enjoy the area. The project requires removing one-quarter of the trees on the mountain.

### Some Points in Favor of the Proposed Change

Several hundred people use Big Mountain each year now. When the project is finished, many thousands will be able to enjoy the beautiful scenery each year. Building the ski resort will create 200 construction jobs. There will be 100 new jobs at the resort. Area restaurants and shops will benefit from the increased number of tourists. The resort will bring in a lot of tax money.

### Some Points Against the Proposed Change

Cutting down one-quarter of the trees on the mountain will be a major change in the natural environment. This will affect many plants and animals. People come to the mountain because it is beautiful and peaceful. This will change too. Thousands more vehicles will bring smog, air and water pollution, and crowding to the small towns in the area.

## ROCKY ROAD OFF-ROAD VEHICLE PARK

### What Is There Now

Grasses and shrubs cover this county-owned land. Until 15 years ago, small herds of sheep and cattle grazed on these coastal hills. Native plants and animals have moved back to the area. Coyotes, bobcats, and rattlesnakes live there now. Hikers use the few hillside trails.

### The Proposed Change

The Recreational Vehicle Association wants the county to turn this land into a hillside park. The park will be an area where off-road vehicle drivers, dirt bikers, and mountain bikers can enjoy their sports. The Association expects several hundred people to use the park every weekend.

### Some Points in Favor of the Proposed Change

This hillside area is not well used. Only a few hikers use the trails. People who want to go dirt biking, mountain biking, and driving off-road vehicles need a place to participate in these activities. There is no area in the county for these popular sports. Some people use private property and state park lands. This is illegal and the county is concerned about it. The Vehicle Association believes providing a special place for these sports will stop the illegal activities.

### Some Points Against the Proposed Change

Driving off-road vehicles and dirt bikes harms plants and animals. Even mountain biking can cause ecosystem damage. Using the trails and roads causes soil erosion. In other areas that allow off-road sports, the trails are over-used. As the trails and roads develop deep ruts, people tend to move onto new areas. This causes further damage to the environment.

## ORCHARD LANE SHOPPING MALL

### What Is There Now

Orchard Lane is a small road in a fruit-growing area of the Central Valley. It is about three miles outside of Valley City. Fruit orchards line both sides of the road. The orchards are 75 years old, and they no longer produce much fruit. The orchards do not provide much habitat for wild species. Crows, magpies, and other birds often feed on the fruit.

### The Proposed Change

The Miller Development Company wants to build a shopping mall on the old orchard land. The mall would serve people from Valley City and the nearby small towns. There are no other malls within 50 miles.

### Some Points in Favor of the Proposed Change

Valley City does not have a shopping mall. For some products, Valley City residents have to drive 50 miles to a larger town. Building a shopping mall would save gasoline and reduce air pollution. People would also save money because local merchants have to charge higher prices than do big chain stores. Building a mall would provide construction jobs. Later, the mall would hire area residents to work in the stores. The mall would also provide tax money for the local economy.

### Some Points Against the Proposed Change

People need food; they do not need a mall. A shopping mall will hurt local businesses in Valley City and other nearby towns. The mall will require paving over a lot of land. Rainwater will not be able to seep into the soil. Instead, it will flow over the pavement, picking up pollutants from the parking lots. Replanting the orchards with a different crop would be a more productive use of this farmland.

## DOWNTOWN PLAZA SHOPPING CENTER

### What Is There Now

The lot on the corner of Fourth Avenue and Williams Street is vacant. Many grasses and weeds grow there. There are many insects and an occasional neighborhood cat or squirrel. During the day, children sometimes play in the lot. They enjoy picking wildflowers and watching bugs. At night, homeless people sometimes sleep in the lot.

### The Proposed Change

The Downtown Development Corporation wants to build a shopping center. The stores would carry popular styles of clothing. A neighborhood group wants to create a community garden and playground on the lot.

### Some Points in Favor of the Proposed Change

The shopping center will bring much needed tax money to the city. Many unemployed people live in the city. The shopping center would provide new jobs. It would also allow people to shop near their homes and support local merchants. They would save time and gasoline because they would not have to shop at the mall outside of town.

### Some Points Against the Proposed Change

A community garden gives people a place to grow their own food. This is helpful to families who live in apartments. Garden-grown fruits and vegetables are healthier, better tasting, and cheaper than store-bought varieties. Many children already play in this lot. Building a playground will make it a friendly and safe place for families. The garden and playground will help stop homeless people from sleeping in this area.

## MOUNTAIN FREEWAY

### What Is There Now

An old two-lane road leads across the mountains in this northern California region. It is the only available road in the area. It closes in winter because of snow. Drivers often see deer, bears, marmots, squirrels, and other forest animals near the road. Trout and several kinds of frogs and salamanders live in the roadside creeks. On occasion, people see mountain lions and bobcats.

### The Proposed Change

Politicians and business leaders want to expand the road. They want to build a six-lane freeway through a pass in the mountains.

### Some Points in Favor of the Proposed Change

People who live in this mountain area want an easier, faster, and safer way to get to the Central Valley. They want a more direct route to Highway 5, which runs all the way up and down California. A larger road will help truckers. It will save them time, fuel, and money. A freeway will bring more business to the small, struggling mountain towns in the area. It might encourage people to move to the area. With a better road system, local land values will increase. More jobs and tax money will come to the area.

### Some Points Against the Proposed Change

Building a six-lane freeway will destroy the surrounding habitat. Many animals that live in the areas will lose their homes. The road will cut through the hunting territories of some predators. These animals will have a hard time finding enough food. It will be dangerous for them to cross the road. Cars and trucks traveling at high speeds will likely strike some animals. These accidents might also injure some motorists. Easier travel could also lead to the growth of the small towns in the area. Then, the small town atmosphere that makes people want to live here will change. Growing towns mean even more loss of land.



Name: \_\_\_\_\_

**Persuasive Essay Peer & Teacher Evaluation** (Lesson 6 Activity Master)

Does the essay:	Peer Evaluation	Teacher Evaluation
Have an interesting headline?	__4 __3 __2 __1	__4 __3 __2 __1
Provide a description of the purposed land use change?	__4 __3 __2 __1	__4 __3 __2 __1
Identify what resources would be affected and the quantities affected?	__4 __3 __2 __1	__4 __3 __2 __1
Identify what populations of organisms would be affected and how?	__4 __3 __2 __1	__4 __3 __2 __1
Describe why those organisms are important to the energy flow in the natural ecosystem?	__4 __3 __2 __1	__4 __3 __2 __1
Identify the function of the affected organisms in the ecosystem?	__4 __3 __2 __1	__4 __3 __2 __1
Clearly state a position, either for or against the proposed change?	__4 __3 __2 __1	__4 __3 __2 __1
Explain why people should agree with your position?	__4 __3 __2 __1	__4 __3 __2 __1
Include any quotations or realistic details, and did they add to the article?	__4 __3 __2 __1	__4 __3 __2 __1
<b>Did you check the essay for:</b>		
Grammar, word use, punctuation, spelling?	__4 __3 __2 __1	__4 __3 __2 __1
Overall apparent effort and neatness?	__4 __3 __2 __1	__4 __3 __2 __1
<b>Did you check the article for:</b>		
	__4 __3 __2 __1	__4 __3 __2 __1

## Unit Visual Aids

**Wolverine in Its Habitat** (Lesson 1 Visual Aid)





**Classroom Populations** (Lesson 1 Visual Aid)

## Which are populations in this classroom?

Highlight or underline all that apply.



**Children**

**Frogs**

**Books**

**Girls**

**Chairs**

**Plants**

**Boys**

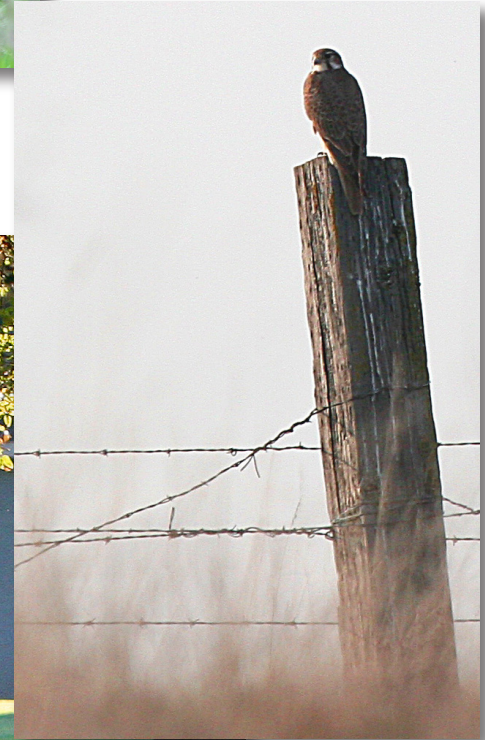
**Students**

**Humans**



**Populations in Nature** (Lesson 1 Visual Aid)

## What populations are shown here?





**Populations in Nature** (Lesson 1 Visual Aid)

**What populations are shown here?**





**Making a Living #1** (Lesson 2 Visual Aid)**Role or Function**

Producer: \_\_\_\_\_

Consumer (herbivores): \_\_\_\_\_

Consumer (carnivores): \_\_\_\_\_

Consumer (omnivores): \_\_\_\_\_

Consumer (scavengers): \_\_\_\_\_

Decomposers: \_\_\_\_\_



**Making a Living #2** (Lesson 2 Visual Aid)**Role or Function**

Producer: \_\_\_\_\_

Consumer (herbivores): \_\_\_\_\_

Consumer (carnivores): \_\_\_\_\_

Consumer (omnivores): \_\_\_\_\_

Consumer (scavengers): \_\_\_\_\_

Decomposers: \_\_\_\_\_



**Organisms and Their Functions** (Lesson 2 Visual Aid)

Match the description of the organism's function at the left with the term at the right. Use each term only once.

Description of Function	Organism
____ <b>1.</b> An organism that gets its energy and materials by breaking down the remains of dead organisms and absorbing the nutrients	<b>a. bacteria</b>  <b>b. carnivore</b>
____ <b>2.</b> An organism whose primary food source is plants	<b>c. consumer</b>  <b>d. decomposer</b>
____ <b>3.</b> An organism such as a plant or alga that uses light energy or chemical energy to produce food (sugars or starches)	<b>e. herbivore</b>  <b>f. omnivore</b>
____ <b>4.</b> A one-celled organism with no nucleus	<b>g. producer</b>
____ <b>5.</b> An organism that eats both plants and animals	
____ <b>6.</b> An organism that obtains energy and materials by eating other organisms	
____ <b>7.</b> An organism whose primary food source is other animals.	

## Sierra Nevada Mountains Ecosystem Organism



# Narrator

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## Sierra Nevada Mountains Ecosystem Organism



# Sun

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## Sierra Nevada Mountains Ecosystem Organism



# Grass

## Producer

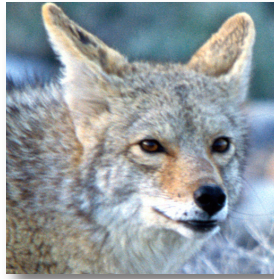
## Sierra Nevada Mountains Ecosystem Organism



# Rabbit

## Primary Consumer

## Sierra Nevada Mountains Ecosystem Organism



# Coyote

## Secondary Consumer

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## Sierra Nevada Mountains Ecosystem Organism

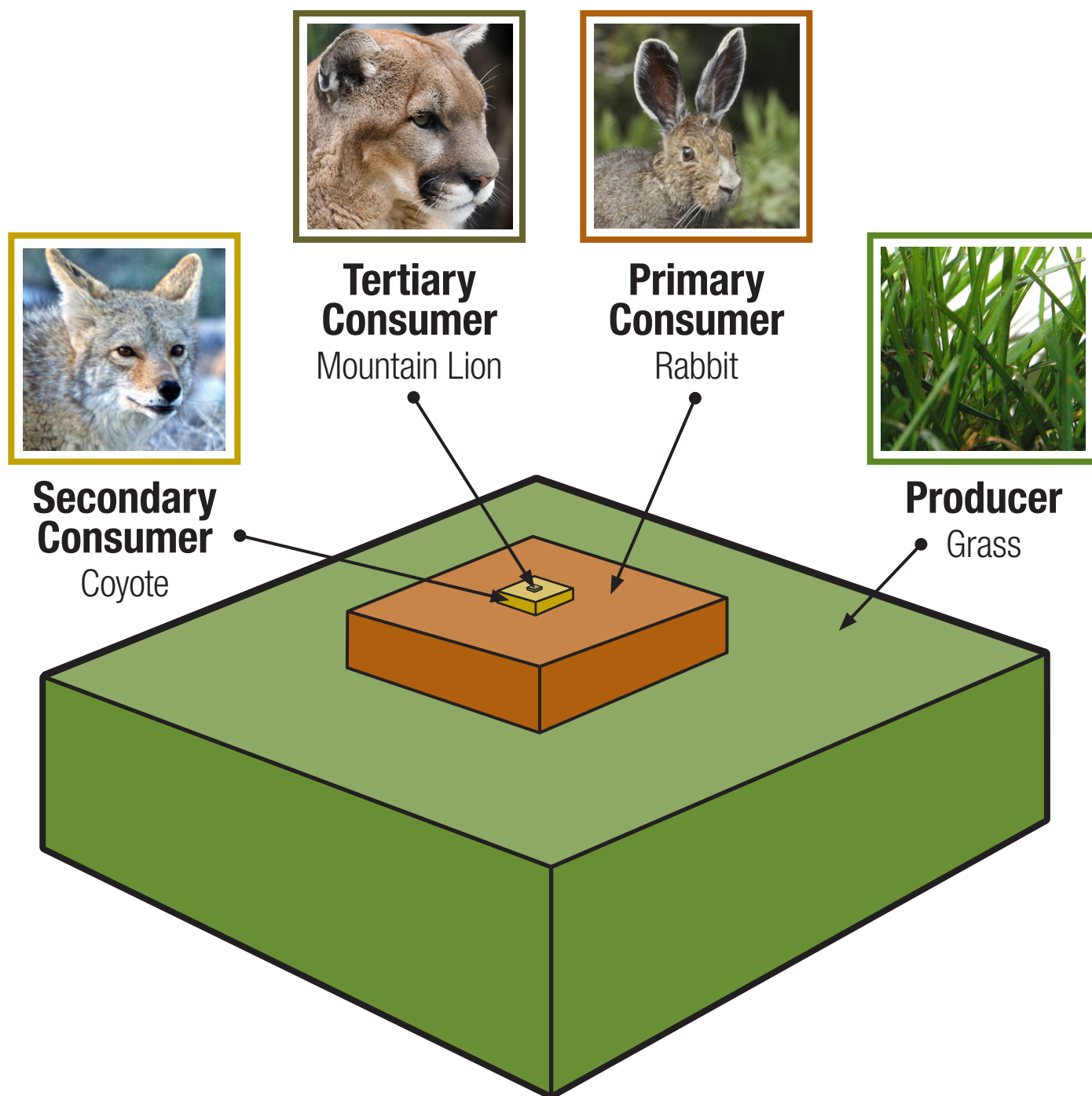


# Mountain Lion

## Tertiary Consumer

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**Mountain Lion Energy Pyramid** (Lesson 3 Visual Aid)**90% Energy Loss at Each Trophic Level**



**Before & After** (Lesson 4 Visual Aid)

